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The political economy of food self-sufficiency policies and food security in African countries

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Food security deteriorated in Africa during the past decade, and the number of undernourished people has been increasing since 2010. The prevalence of undernourishment is now above pre-pandemic levels at 9.7% compared with 7.2% in 2019, and Africa reports the highest level in the world. External factors, such as the Russia-Ukraine conflict, have contributed to this increase Projections show that almost 600 million people in Africa will be chronically undernourished in 2030. Moreover, Africa is not on track for SDG2, eradicate hunger by 2030.

To achieve food security and reduce the number of undernourished people, many policymakers are advocating for food self-sufficiency. Relying on local production and promoting it through various policy measures, including restrictive trade policies, appears to many to be a natural solution. Yet, there has been a long-standing debate among analysts as to whether trade restrictions are a good strategy, especially in Africa, to achieve food security. The proponents of food self-sufficiency argue that trade liberalization increases food dependency (and import bills) and makes consumers vulnerable to external shocks in food availability, as well as exposing them to unhealthy foods. They advocate for stimulating local production with subsidies and trade restrictions. For the opponents, opening borders to international trade is a guarantee of cheap and easy access to diversified food products. Furthermore, by partially decoupling local markets from domestic shocks, trade can also help stabilize domestic food markets.

This report contributes to that debate. Using both qualitative and quantitative analysis, we reach the conclusion that food self-sufficiency is neither a necessary nor a sufficient condition for food security. Food security is a multidimensional concept, and only two dimensions– availability and utilization—seem to be affected by food self-sufficiency in Africa. Also, while public support to agriculture can help achieve food self-sufficiency, its impact is not linear, and beyond a certain threshold, diminishing returns are observed. Overall, different approaches can achieve food security, and there is no "one-size-fits-all strategy." International or regional trade can contribute to food security and stabilize domestic food markets, as regional production is usually less volatile than domestic supply.

RESUME

La sécurité alimentaire s'est détériorée en Afrique au cours de la dernière décennie. Le nombre de personnes sous-alimentées augmente depuis 2010. La prévalence de la sous-alimentation est supérieure aux niveaux d'avant la pandémie : 9,7 contre 7,2 % en 2019. Des facteurs externes tels que le conflit entre la Russie et l'Ukraine ont contribué à cette situation et le continent enregistre les chiffres les plus élevés dans le monde. Les projections montrent que près de 600 millions de personnes souffriront de sous-alimentation chronique en 2030 sur le continent. L'Afrique n'est pas sur la bonne voie pour atteindre l'ODD2, qui vise à éradiquer la faim d'ici 2030.

Pour parvenir à la sécurité alimentaire et réduire le nombre de personnes sous-alimentées, de nombreuses voix parmi les décideurs politiques plaident en faveur de l'autosuffisance alimentaire. S'appuyer sur la production locale et la promouvoir par diverses mesures politiques, notamment des politiques commerciales restrictives, semble être une solution naturelle. Pourtant, les analystes débattent depuis longtemps sur la question de savoir si l'ouverture commerciale est ou non une bonne stratégie, notamment en Afrique, pour parvenir à la sécurité alimentaire. Les partisans de l'autosuffisance alimentaire soutiennent que la libéralisation des échanges accroît la dépendance alimentaire (et les factures d'importation) et rend les consommateurs vulnérables aux chocs externes concernant la disponibilité alimentaire, ainsi qu'à l'exposition à de la nourriture pas saine (malbouffe). Ils plaident pour stimuler la production locale par des subventions et des restrictions commerciales. Pour les opposants, l'ouverture des frontières au commerce international est la garantie d'un accès facile et bon marché à des produits alimentaires diversifiés. En outre, en découplant partiellement les marchés locaux des chocs intérieurs, le commerce peut également contribuer à stabiliser les marchés alimentaires nationaux.

Le rapport contribue au débat susmentionné. À l'aide d'analyses à la fois qualitatives et quantitatives, il arrive à la conclusion que l'autosuffisance alimentaire n'est ni une condition nécessaire ni suffisante pour la sécurité alimentaire. Ce dernier est un concept multidimensionnel, et seules les dimensions de disponibilité et d'utilisation semblent être affectées par l'autosuffisance alimentaire en Afrique. En outre, même si le soutien public à l'agriculture peut contribuer à atteindre l'autosuffisance alimentaire, son impact n'est pas linéaire et, au-delà d'un certain seuil, des rendements décroissants sont observés. Dans l'ensemble, il existe diverses manières d'atteindre la sécurité alimentaire et il n'existe pas de « stratégie universelle ». Le commerce international ou régional peut contribuer à la sécurité alimentaire et stabiliser les marchés alimentaires nationaux dans la mesure où la production régionale est le plus souvent moins volatile que l'offre nationale.

INTRODUCTION

While food security has been identified as a universal human right by the Office of the United Nations High Commissioner for Human Rights, the number of undernourished people in Africa has been steadily increasing since 2010. According to the Food and Agriculture Organization of the United Nations (FAO), 278 million people in Africa (about 3.5% of the world population) were undernourished in 2021 compared to 171 million (about 2.5% of the world population) in 2010. It is projected that almost 600 million people globally (about 6.2% of the world population) will be chronically undernourished in 2030, about half of them in Africa. This is about 119 million more than in a scenario in which neither the pandemic nor the Russia-Ukraine war occurred, and around 23 million more than if the war had not happened. This situation highlights the immense challenge of achieving Target 2 of the UN Sustainable Development Goals, (SDGs) of eradicating hunger, particularly in Africa (SOFI, 2023). In addition to food security, international and regional institutions such as FAO and the African Union have designated nutrition security as a priority objective. The Malabo Declaration explicitly mentions food and nutrition security in the commitments to ending hunger. This goes beyond ensuring access of each individual to sufficient food, adding the need for healthy and nutritious food that meets dietetic needs and food preferences for an active and healthy life. Food and nutrition security is thus a multidimensional goal that requires investment in agricultural systems and rural areas, investment in health and education, improved market access, social protection and safety nets for households, improved governance, and economic policies (Gross et al., 2000; FAO, 2022).

In the toolbox available to policymakers for achieving food security, trade policy plays a key role. There has been a long-standing debate about this role among policymakers and the public, questioning whether or not trade openness is a good strategy, especially in Africa (Gnedeka and Wonyra, 2023; Guerrieri and Caffarelli, 2012). On the one hand, some analysts argue that countries should pursue a goal of food *self-sufficiency* in order to secure sufficient agricultural production for the food needs of the local population. In addition, there is consensus that the ability of the least developed countries (LDCs) to benefit from agricultural trade liberalization is limited by severe supply constraints constraining their exports (Koning and Pinstrup-Anderson, 2007; De Schutter, 2011). One of the most cited arguments against free trade is that it increases food dependency (and import bills) and exposes consumers to external shocks in food availability, as well as promoting consumption of unhealthy foods[1] (through an evolution known as the nutrition transition) (Global Panel, 2020). Moreover, developed countries have traditionally supported their agricultural sectors and protected their local producers from import competition (Anderson, 2008). This situation made agricultural production more attractive for domestic farmers and resulted in the over-production of farm products in high-income countries (IFAD, 2022). It is then necessary to stimulate local

[1] Fat, sugar and unhealthy foods.

production by subsidies, protect it from international competition by levying customs duties or even through quantitative restrictions.

On the other hand, it is believed that the best way for people to access food in sufficient quantity and quality is to open borders and remove all barriers to international trade. This not only makes access to agricultural and food products easier and cheaper, but also allows farmers around the world sell everywhere and thus creates incentive to invest more in agricultural production capacities. As a result, agricultural production will increase and consumers everywhere will have access to more agricultural products at lower prices. Indeed, when Pareto-equivalent compensation payments are made, free trade does not lower the economic welfare of any individual and, on average, increases economic welfare in the countries involved in such trade (Smith and Glauber, 2018). However, if food prices spike due to global or local production shortfalls, the policymaker's first action is often to introduce export restrictions to increase the availability of important commodities in the country (Gouel, 2014). For instance, rice-importing countries in sub-Saharan Africa have felt the greatest impacts (a price increase of more than 20% after six months) when India imposed export restrictions in July 2023 to temper El Niño effects on domestic supply (Glauber and Mamun, 2024).

However, new arguments are emerging for promoting regional food self-sufficiency (that is, the ability of the regional community to provide sufficient agricultural production to meet regional demand) to stabilize domestic markets, as production levels are less volatile at the regional level than at the national level (IFPRI-ATOR, 2013). Moreover, regional trade has potential to improve food security, as surplus areas can supply deficit areas affected by weather shocks. These ideas aim to develop regional potential and opportunities through subsidies, the development of regional value chains, free intra-regional trade, and the protection of local producers through the common external tariffs.

This report is part of the Mastercard Foundation Project's (MFP) trade component. It analyzes the political economy of food self-sufficiency policies and food security in African countries, with a particular focus on eight target countries (Ghana, Kenya, Mozambique, Nigeria, Rwanda, Senegal, Tanzania, and Uganda). The report contributes to the literature by answering the questions, with a focus on Africa, (1) is food self-sufficiency either a necessary or a sufficient condition to achieving food security?, and (2) are agricultural support policies efficient in achieving food self-sufficiency? In particular, it examines the extent to which the abovementioned vision of promoting food self-sufficiency as a means to achieve food security is grounded in theoretical and empirical facts. The approach used combines descriptive analysis and econometric estimations using quantile regressions to highlight the heterogenous effects of agricultural support on food self-sufficiency.

The report is structured as follows. First, it provides definitions of the relevant concepts and presents some key indicators in Section 2. Section 3 describes the levels of agricultural support and protectionism in Africa. Section four reviews an empirical analysis conducted to test the links between agricultural support and protectionism, food self-sufficiency, and food security. The final section concludes.

DEFINITIONS: FOOD SECURITY AND FOOD SELF-SUFFICIENCY

What is food security?

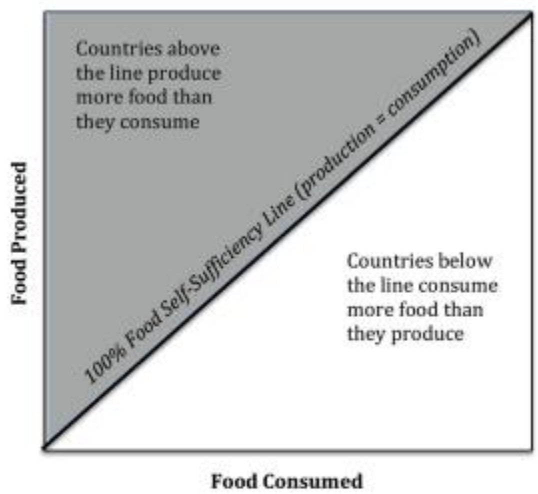
According to the Food and Agricultural Organization of the United Nations (FAO), food security is reached "when all people have physical and economic access at all times to adequate food or the means for its procurement, without discrimination of any kind" (FAO 2015).

As highlighted by Díaz-Bonilla (2015), there is now a consensus that food security is a multidimensional concept with at least four pillars: (1) availability, (2) access, (3) utilization, and (4) stability. Looking at this more complex definition, it becomes clear that achieving food security is a major challenge. Food availability depends on domestic production, food stocks, and net food trade. Access to food at the household level is influenced by income and employment, and thus by economic growth and development. Utilization of food depends on the quality of food, health services, water and sanitation infrastructure, education, and women's participation in economic and social life. Stability is related to the absence of shocks along food value chains from production to consumption.

What is food self-sufficiency?

Food self-sufficiency is also a complex concept. According to FAO (1999), it reflects "the degree to which a country meets its food needs through its own domestic production." It is generally measured by economists as the ratio of food production to food consumption, measured either in quantity, in value, or in calories. This indicator further complicates the issue, as illustrated in Figure 1. In this figure, we can represent the situation of a country in terms of food consumption (on the horizontal axis) and food production (on the vertical axis).

Figure 1: Representation of food self-sufficiency



Source: Clapp (2017).

If a country's statistics place it below the diagonal food self-sufficiency ;ine, in the white area, the country consumes more than it produces. If it falls above the diagonal, in the gray area, it produces more than it consumes. If a country is located on or above the diagonal line, it is self-sufficient. However, self-sufficiency does not mean that all national food consumption is provided by domestic producers. Indeed, a self-sufficient country may export and import food products, with exports as high as its imports. All domestic production is therefore not sold locally because part of it is exported, but an equivalent amount is imported.

An alternative definition of self-sufficiency implies that the country is closed to any exchange of food with the rest of the world, rather than that its food production equals its food consumption. Note that no country in the world meets this definition. Even a country that may be seen as closed such as North Korea does not meet this condition (indeed, China, its main import partner comprises 99% of its imports, and receives 70% of its export) (UN COMTRADE, 2022).

In the next section, we present the indicators for assessing a country's levels of food security and food self-sufficiency and characterize the level of these indicators in Africa.

FOOD SECURITY AND FOOD SELF-SUFFICIENCY IN AFRICA: A STATE OF PLAY

The state of play for food security and food self-sufficiency is presented here in a descriptive analysis. We focus on food security and food self-sufficiency indicators mostly presented in the literature and available in FAOSTAT, or computable from the FAOSTAT database. Whenever possible a gender dimension is included in the analysis to highlight the specificities of gender groups.

Indicators of food security

As indicators of food security, we select here (1) food *availability* based on the dietary energy supply compared to the requirement needed, (2) food *access* based on prevalence of undernourishment, (3) food *utilization* considering the prevalence of anemia among reproductive women and the prevalence of stunted children (under five), and (4) food *stability* using the food price variation indicator over the period 2000–2019.

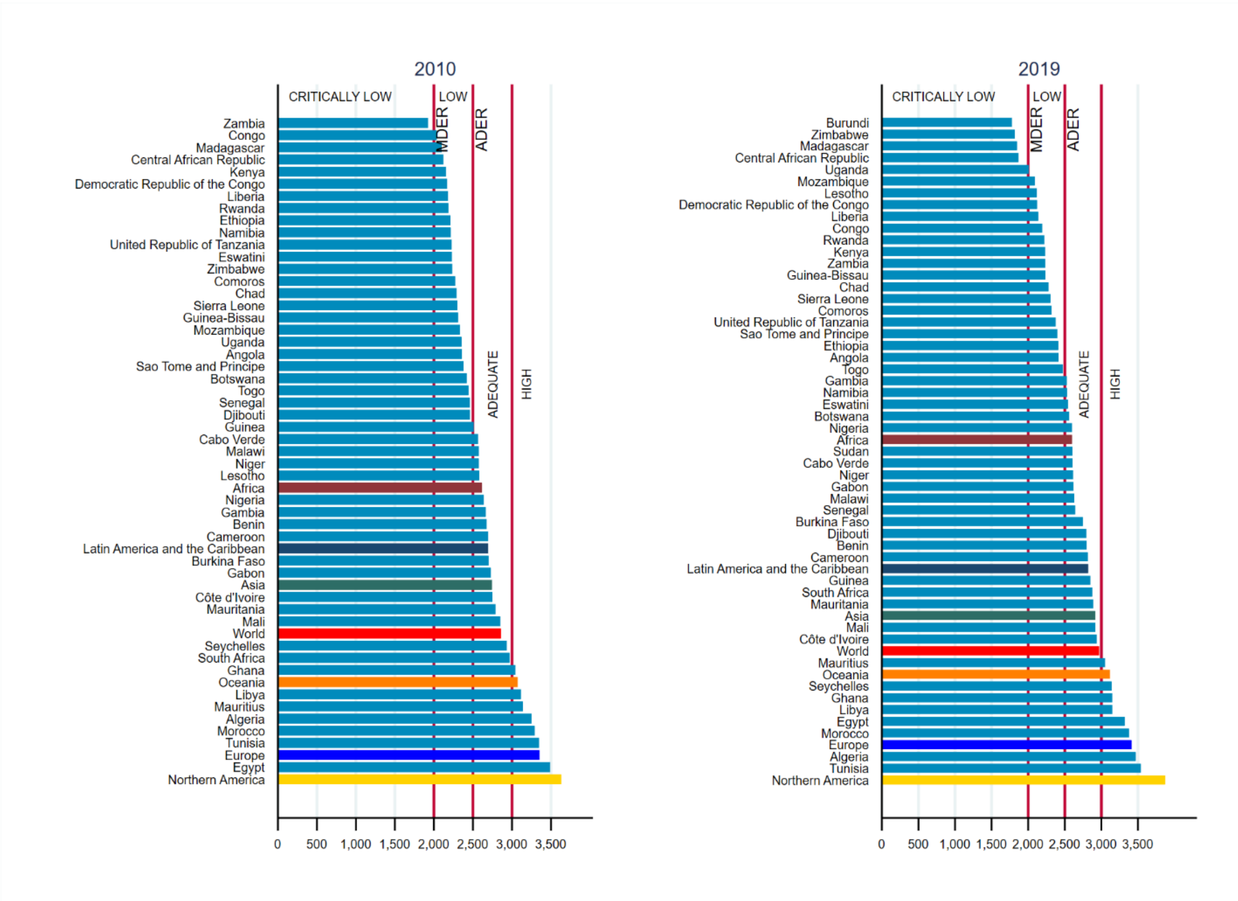
Food availability (observed versus requirement)

The dietary energy supply (kcal/capita/day) is an indicator calculated at the national level that serves as an estimate of the quantity of calories from foods available for human consumption[2]. Comparing the indicator of food availability with the minimum dietary energy requirement (MDER) and the average dietary energy requirement (ADER) allows us to classify countries based on their levels of food availability. The MDER is defined as the amount of dietary energy that is adequate to maintain a minimum weight for health. The ADER is the amount of dietary energy needed to maintain average body weight for long-term good health, that is an amount equal to energy expenditure. We follow the approach of Pokka et al. (2013) and set the MDER at 2000 kcal and the ADER at 2500.

The levels of food availability in different African countries and its benchmarks are presented in Figure 2. From 2010 to 2019, the structure of Africa's dietary energy supply did not change, and the supply remains low compared to the rest of the world (it remains the highest in North America and Europe). Half of African countries did not reach the ADER over the period 2010–2019. Over this period, seven of the eight focus countries in this study registered an improvement in food availability. Only Uganda showed no improvement (Figure 4). However, **Figure 2** and **Figure 3** show that out of the eight countries, only Nigeria, Ghana, and Senegal reached the ADER.

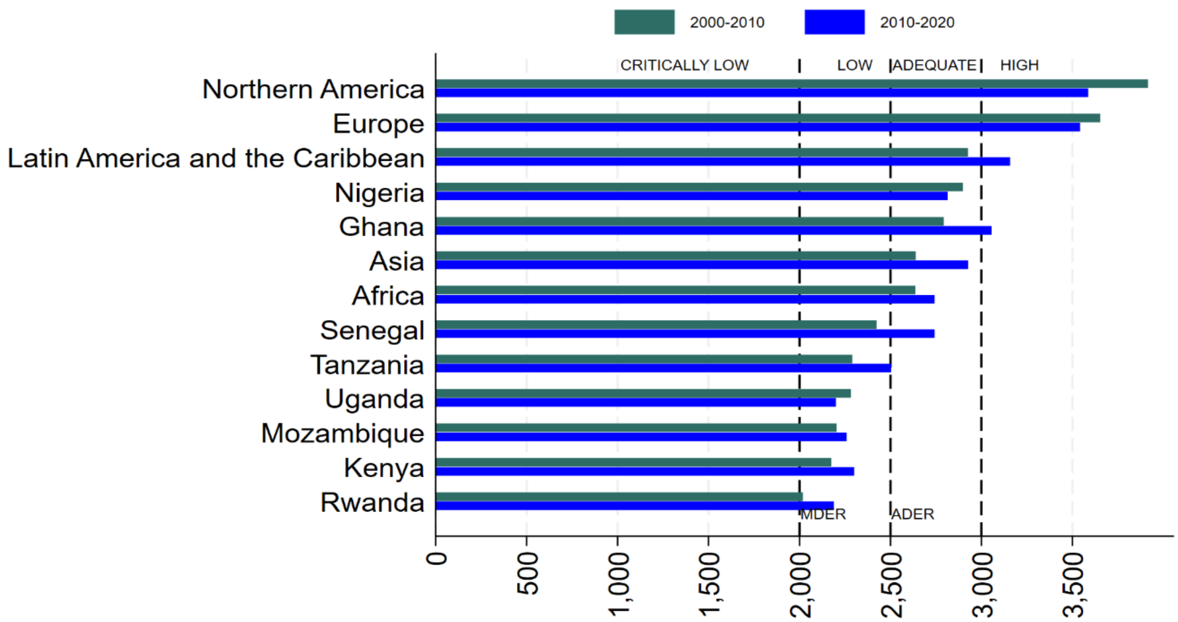
[2] https://inddex.nutrition.tufts.edu/data4diets/indicator/dietary-energy-supply

Figure 2: Dietary energy supply (kcal/capita/day) in Africa, 2010–2019



Source: Author's calculations using FAOSTAT (2023) data.
Note: ADER: Average Dietary Energy Requirement; MDER: Minimum Dietary Energy Requirement.

Figure 3: Dietary energy supply (kcal/capita/day)



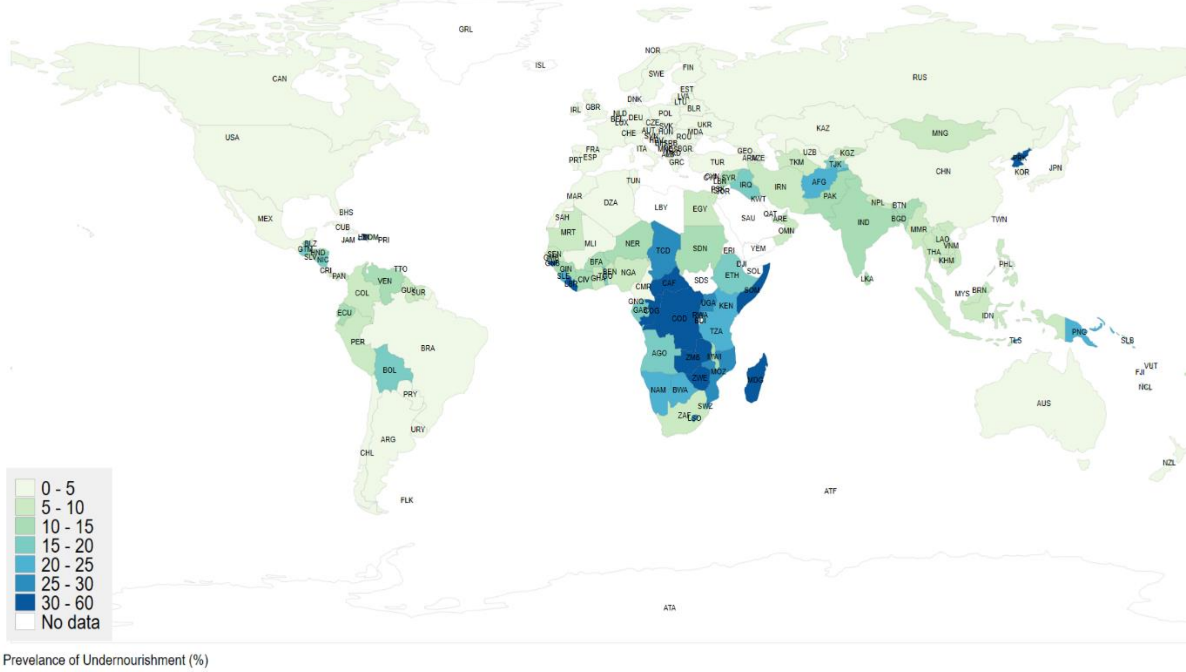
Source: Author's calculations using FAOSTAT (2023) data.

Food access: Prevalence of undernourishment

The prevalence of undernourishment (PoU) expresses the probability that a randomly selected individual in the population consumes a quantity of calories that is insufficient to cover her/his energy requirement for an active and healthy life (MDER). The indicator is computed by comparing a probability distribution of habitual daily dietary energy consumption with MDER (FAOSTAT, 2023).

The PoU in Africa is high (see Figure 4), at double the world average. Africa's PoU increased between the 2000–2010 and 2010–2020 periods. In the first period, it averaged 15.8 percent, and worsened in the second period, when it averaged 20 percent . During this time, PoU also increased, though only slightly, in Latin America and the Caribbean (from 5.7% to 9.4%) but decreased slightly in Asia from 13.1% to 8.0%. The PoU remains quite high in some African countries (notably Central African Republic, Madagascar, Democratic Republic of the Congo, Liberia, Rwanda, Lesotho, Chad, Guinea-Bissau, and Somalia), while it remains low in others (including Côte d'Ivoire, Senegal, Benin, Ghana, and Tunisia).

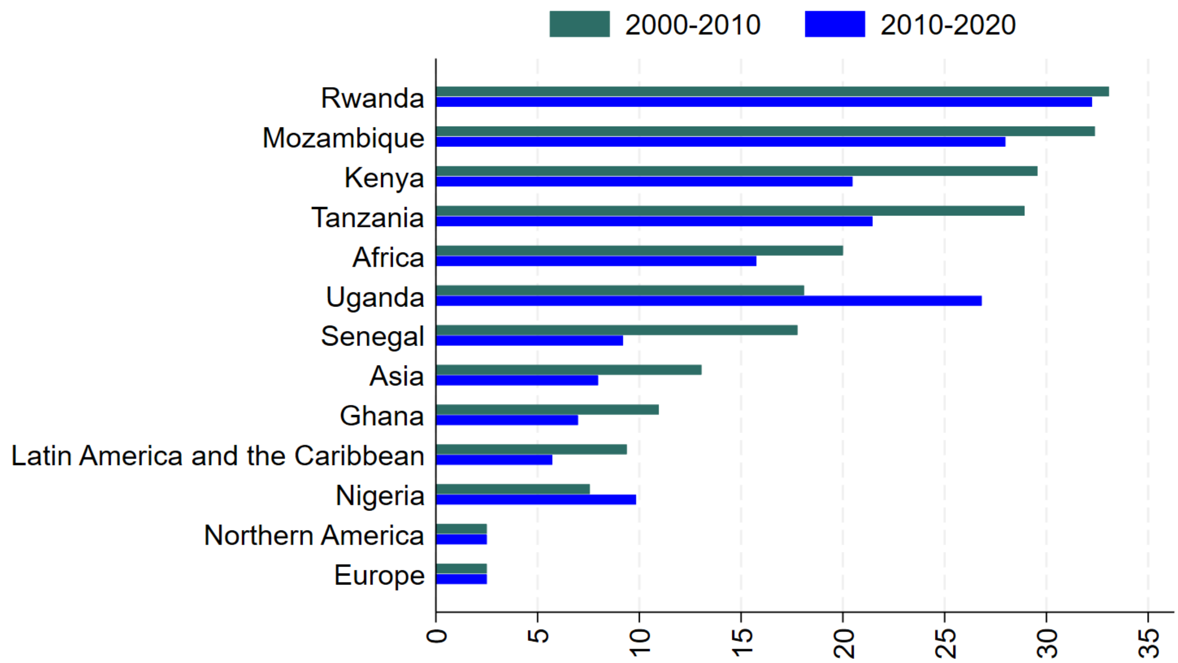
Figure 4: Prevalence of undernourishment over the period 2010–2020



Source: Author's calculations using FAOSTAT (2023) data.

Figure 5 spotlights the PoU in the periods 2000–2010 and 2010–2020 in the eight focus countries of the Mastercard Foundation project and a set of regions used as benchmarks. Of the eight countries, four have a PoU below the continental average. The PoU decreased between the two periods in six of the eight countries, but increased in Nigeria and Uganda.

Figure 5: Prevalence of undernourishment in the 8 target countries and some benchmark regions (%)



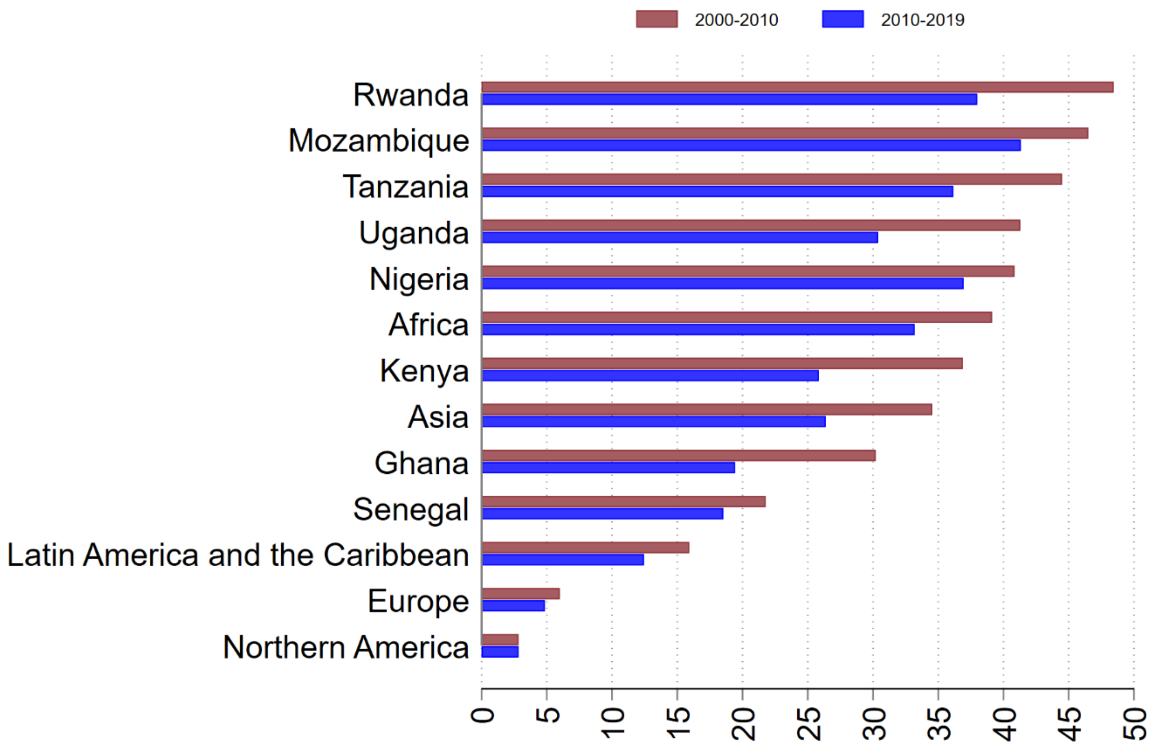
Source: Author's calculations using FAOSTAT (2023) data.

Food utilization: Percentage of children under five who are stunted

The rate of stunting in children under age five is part of a set of indicators used to measure nutritional imbalance and malnutrition that result in undernutrition (assessed by underweight, stunting, and wasting) or overweight. Child growth is the most widely used indicator of nutritional status in a community and is internationally recognized as an important public-health indicator for monitoring health in populations. In addition, children who suffer from stunting as a result of poor diets and/or recurrent infections tend to have a greater risk of suffering illness and death (FAO, 2022). Children are considered stunted if they are below minus two standard deviations from the median height-for-age based on the WHO Child Growth Standards.

Figure 6 presents the percentage of children under five who are stunted over the periods 2000–2010 and 2010–2019. Africa remains the world region with the highest percentage of children under five who are stunted, with rates of 40 percent in the 2000–2010 period and 33 percent in the 2010–2019 period. Five of the eight target countries (Rwanda, Mozambique, Tanzania, Nigeria, and Uganda) have stunting levels above the continental average. These results reflect the cumulative effects of undernutrition and infections since birth, and even before birth. It is worth noting that, in all eight countries, the percentage of children under five who are stunted decreased between the two periods.

Figure 6: Percentage of children under five who are stunted in the 8 target countries and the benchmark regions



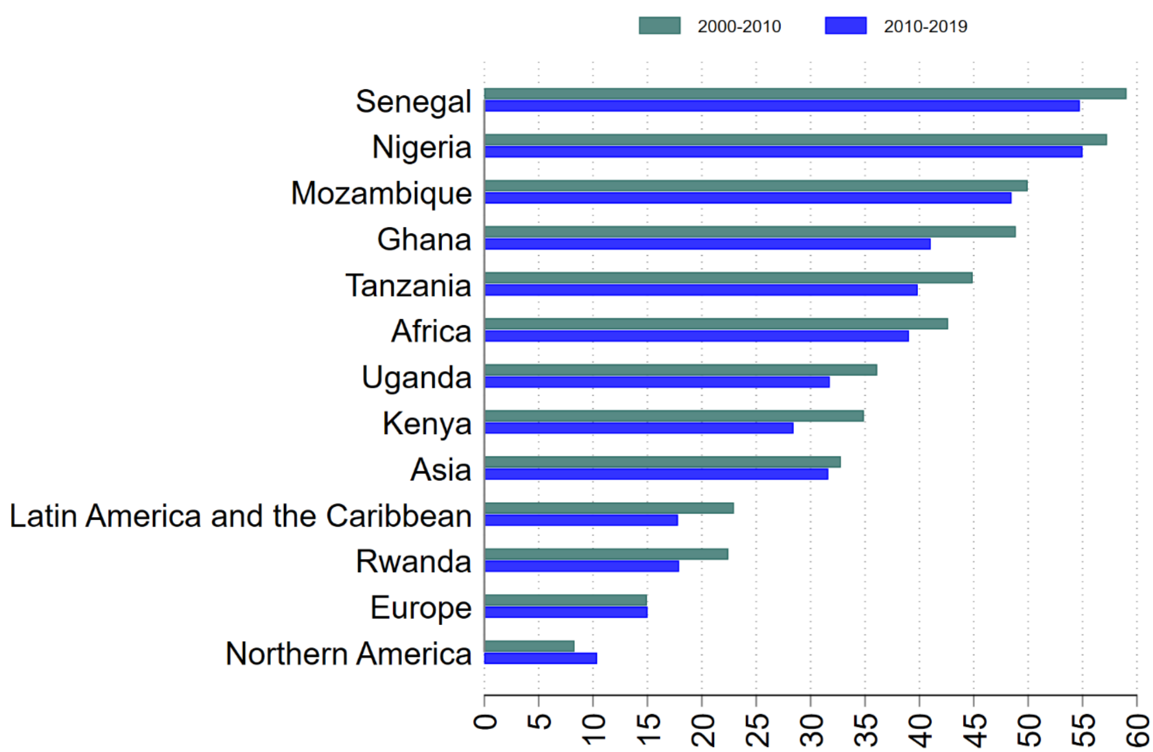
Source: Author's calculations using FAOSTAT (2023) data.

Food utilization: Prevalence of anemia among women of reproductive age (15–49 years)

Anemia is a serious public health problem in Africa. The prevalence of anemia among women of reproductive age remains higher in Africa (around 40 percent over the period 2000–2019) compared to other regions (see Figure 7). In Senegal, the prevalence of anemia among women of reproductive age was about 55 percent over the period. In addition, five (Senegal, Nigeria, Mozambique, Ghana, and Tanzania) of the eight focus countries recorded a prevalence of anemia among women of reproductive age above 40 percent (see Figure 7). The consequences of anemia for the health and the economic performance of women are multiple. Anemia decreases the participation of women in the labor market, as well as their productivity, and as a result, their empowerment.

The situation in Senegal, where the prevalence of anemia is high but the stunting rate are high, has drawn our attention. According to the Senegal's Cellule de Lutte contre la Malnutrition (CLM) (Malnutrition Control Unit), Senegal is recognized as having one of the most efficient and ambitious nutrition service delivery systems in Africa. The 46% reduction in the child stunting rate from 34.4% in 1992 to 19.4% in 2014 is among the fastest rates of improvement in malnutrition in the world, and Senegal currently has one of the lowest rates of stunting in sub-Saharan Africa (CLM, 2018). Nevertheless, other nutrition indicators are stagnant, and other issues with serious implications (low birthweight, iron deficiency, anemia, maternal undernutrition, and child malnutrition) have received little or no attention (CLM, 2018). It is important to keep in mind that there has not a direct link between anemia among women of reproductive age and the prevalence of children under five facing stunting. Anemia is usually the consequence of dietary iron deficiency (DeMaeyer, 1989; Yip, 1994), while stunting reflects chronic malnutrition. Both definitions show that anemia is a circumstantial problem while stunting is a structural problem.

Figure 7: Prevalence of anemia among women of reproductive age (15–49 years)



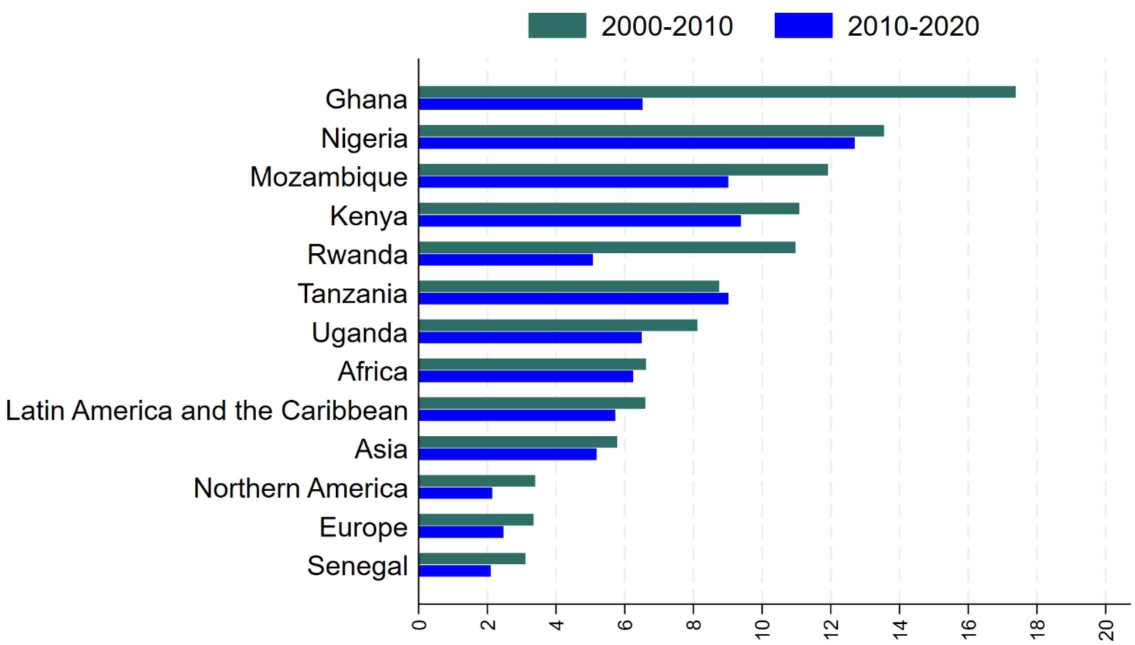
Source: Author's calculations using FAOSTAT (2023) data.

Food stability: Food price variation

The stability dimension of food security reflects the absence of volatility of the first three dimensions (availability, access, utilization). Here we use food price variation, defined as the average growth rate of the consumer price index, which tracks the evolution of consumers' purchasing power, to measure the stability of food access. Figure 8 presents the food price variations (as measured by the average growth rate of the consumer price index, in the eight target countries and the benchmark regions for the periods 2000–2010 and 2010–2020. Like the first three dimensions, the Africa region remains the most vulnerable to shocks affecting food prices and this exposure did not significantly change between the two periods.

Apart from Senegal, prices remain more volatile in the focus countries, with volatility levels higher than the average of the Africa region and the benchmark regions.

Figure 8: Food price variations in the 8 target countries

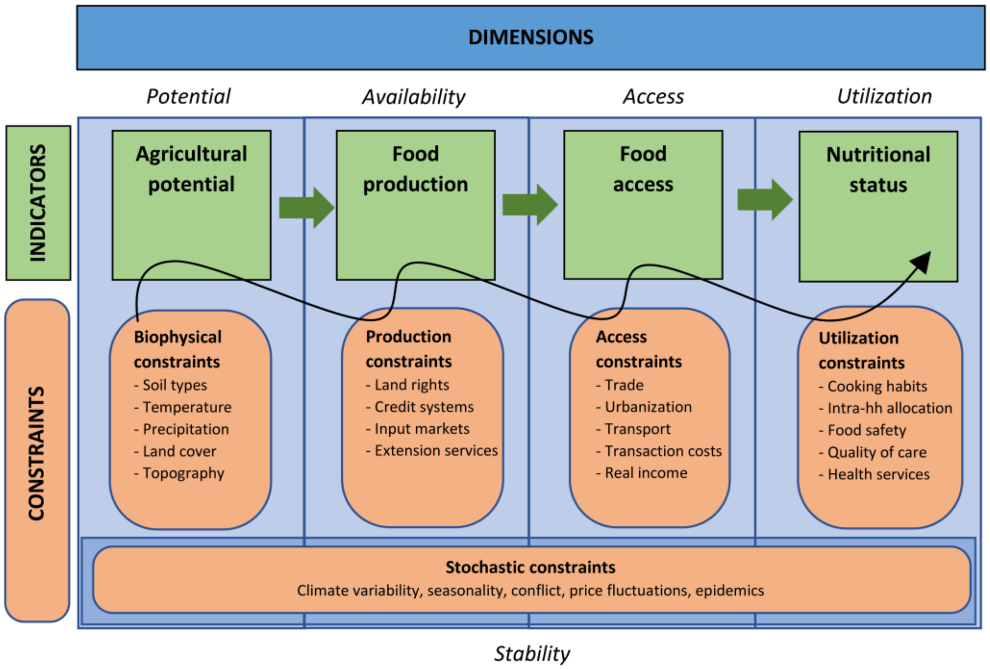


Source: Author's calculations using FAOSTAT (2023) data.

Constraints to food and nutrition security

As discussed, the definition of food security covers four dimensions, or pillars: availability, access, utilization, and stability. Figure 10 below, proposed by Pangaribowo et al. (2013), highlights these dimensions in a sequential way, with a causal chain. The first three dimensions imply a chronological sequence, with stability as a cross-cutting dimension, which refers to the absence of shocks along the entire food system from production to consumption. The three sequential dimensions are associated with four main indicators (agricultural potential, food production, food acquisition, and nutritional outcomes). As shown in the figure, these dimensions and indicators are related to constraints (deterministic or stochastic) that affect the transition from one dimension to the next and may impede improvement in the particular dimension under consideration. This approach aims to explain nutritional outcomes as a combination of inefficiencies of different types and degrees. To improve nutritional outcomes, a country first must have good agricultural potential, then convert that potential into production. Once agricultural potential is converted into production, access (both physical and economical) constraints may arise. Finally, even with good access, utilization constraints, such as bad cooking habits and intra-household misallocation, can be an obstacle to achieving desired nutritional outcomes.

Figure 10: Constraints to food security



Source: Pangaribowo et al. (2013).

Having identified key indicators and constraining factors along each of the four dimensions of food and nutrition security, Table 1 summarizes the constraints for four of the eight target countries, based on work by Marivoet et al. (2018), who developed a spatial food and nutrition security typology approach to identify the constraints associated with the different dimensions of food security. The main conclusion from these studies is that constraints (inefficiencies) are generally present at each stage and public policies lack targeting.

Table 1: Constraints for food and nutrition security in selected African countries

Countries	Constraints
Ghana	• Inappropriate transport, storage, and processing infrastructure to link northern production sites to southern consumption centers. • High level of preharvest (pests, disease, lack of rainfall, agricultural inputs, etc.) and postharvest (handling, storage, processing, and distribution) losses. For example, loss estimates range from 14% to 35% for maize; 7% to 30.7% for rice; 7.5% to 26.3% for sorghum; and 7% to 26% for millet. • Although access inefficiencies are ubiquitous across the country, the districts of Bawku, Gonja, Gushiegu, Saboba Chereponi, Nkwanta, Afram Plains, Amansie, Aowin-Suaman and Asunafo suffer from both lower-than-average access efficiencies and the highest anemia rates among women of reproductive age, making them high-priority areas.
Kenya	• High level of post-harvest losses. • Production inefficiencies exist and alternatives to nutritious food imports is urgent.

	• Inefficiencies in the livestock sector impede production of sufficient vitamin B12.

Nigeria	• Production constraints
	  ○ Low crop productivity.
	  ○ Low levels of fertilizer use, limited use of improved seed varieties, poor infrastructure related to water management, inadequate extension services, high post-harvest losses, limited use of labor-saving and appropriate technologies, and a poor policy environment (Feed the Future, 2018).
	  ○ Prevalence of conflict and insecurity is likely to have a crosscutting impact on all farming activities of households (FEWS NET, 2021).
	• Access constraints
	  ○ Growing population pressure (particularly in urban areas).
	  ○ Internal conflict: Disruptions caused by conflict and insecurity can explain low food accessibility in areas along the Lake Chad basin and in east-central Borno State bordering Cameroon, areas that traders avoid for fear of attacks (FEWS NET, 2021).
	  ○ Conflict and insecurity are considered immediate and crosscutting drivers of acute food insecurity in Nigeria, especially in the northern states (FAO, 2021c).
	• Utilization constraints
	  ○ Poor access to drinking water, improved sanitary conditions and quality healthcare
	  ○ Crosscutting impact of conflict and insecurity on various drivers of utilization.
	  ○

Senegal	• Production constraints
	  ○ Lack of access to agricultural extension services, land, and quality inputs.
	  ○ Additional stochastic constraints (due to climate change).
	• Access constraints
	  ○ Poor market connectivity.
	• Utilization constraints
	  ○ Further research is required to identify the exact drivers of the variation in utilization efficiency, which might relate to differences in access to drinking water, sanitary conditions, and quality healthcare (Foundiougne, the center of the country as well as in Kanel and Medina Yoro Foulah...)
	  ○ Lack of knowledge on the nutritional value of a diversified diet in Dagana

Source: Marivoet et al (2019, 2020, 2021).

Indicators of food self-sufficiency

We use three indicators to measure food self-sufficiency: (1) the share of domestic consumption supplied by domestic production, (2) dietary energy production compared to the amount required for food self-sufficiency, and (3) exposure to the rest of the world, defined as the net trade position, with a positive net trade position defined as food self-sufficiency.

Food self-sufficiency ratio

Food self-sufficiency can be defined as the ratio of a country's domestic food production to its food consumption. The food self-sufficiency ratio (FSSR) provides evidence as to whether the country produces enough food to meet domestic demand. Because consumption is not directly estimated in all countries over the years, the FSSR is estimated as production plus imports minus exports (stock variations are sometimes considered).

Food Self Sufficiency Ratio = 100*Production/ (Production + Imports – Exports)

It is also important to note that the level of postharvest losses and processed products, as well as stocks which may fluctuate from year to year, can bias (overestimate or underestimate) the food self-sufficiency ratio. The ratio can be calculated at the level of one product or for a class of commodities such as cereals or vegetable oils.

Most FSSR analyses focus on key staple crops, such as cereals and starchy roots, in order to give an approximation of a country's food self-sufficiency. Indeed, one should be cautious about using an FSSR based on all commodities because this may mask instances where a country produces one food commodity in abundance while needing to rely on imports for other food commodities, (FAO, 2012). The FSSR can also be estimated for the groups of products of the EAT Lancet commission's Healthy Reference Diet or from FAOSTAT. The approach adopted in this report considers all agrifood products and computes the aggregate food self-sufficiency ratio by country based on the approach developed by Porkka et al. (2013) presented below.

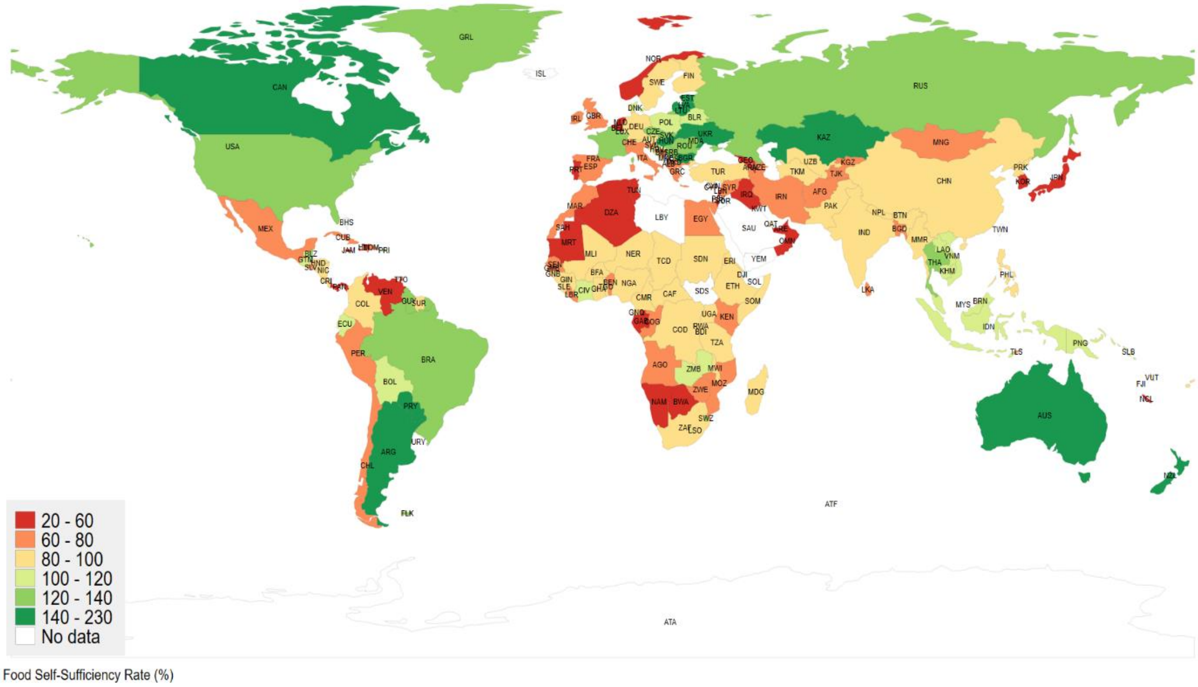
$$FSSR(\%) = 100 * \frac{Production}{Production + Imports - Exports}$$

where production, imports, and exports are in kcal/cap/day.

We used the FAOSTAT database, which includes the food supply for each product, each year, and each country in both kcal/cap/day and quantity, to convert production, imports, and exports to kcal/cap/day. We compute the conversion rate using the ratio between the food supply in kcal/cap/day and the food supply in quantity. Once the annual conversion rates for each product and each country are estimated, we develop a robust approach to estimate the conversion rate from quantity to calories for each product by using additional information from the FAO handbook, which provide the standard conversion rates for each product.

The FSSR over the period 2010–2020 is heterogeneously distributed over the regions; it is very low in Africa and Asia, high in Europe, and very high in Latin America and North America (see Figure *9*).

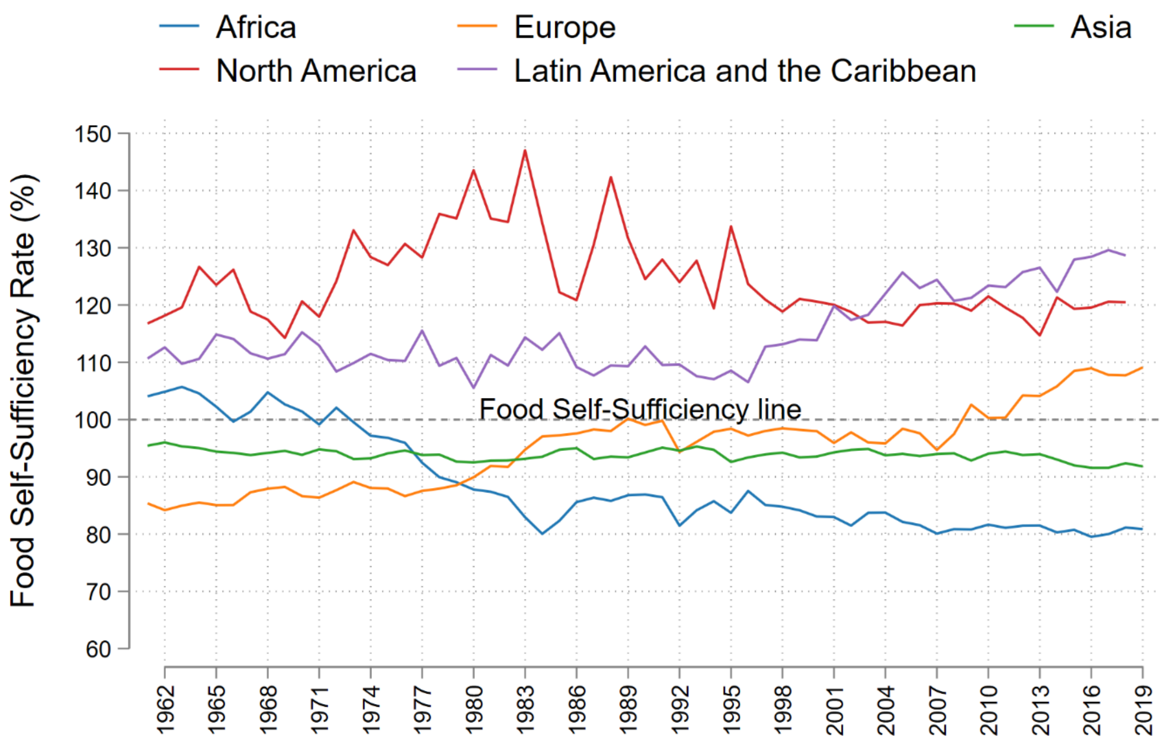
Figure 9: Food self-sufficiency ratio (%) over the period 2010–2020 in the world



Source: Author's calculations using FAOSTAT (2023) data.

Overall, Africa's FSSR decreased over the period 1961–2019, from 106 percent in 1961 to 81 percent in 2019, remained the below all other world regions over the 1980–2019 period (see Figure 10). This result is confirmed by Luan et al. (2013), who found that Africa's FSSR had declined from 100% in 1961 to 80% in 2007. This spotlights the deterioration of the capacity of the African continent to meet its own fast growing population's food demand in the past 50 years. The decreasing trend is mainly explained by the low agricultural productivity in the continent, mainly due to minimal input use, as well as the challenges due to climate change, (OECD/FAO, 2016; Benin, 2016; Van Ittersum et al., 2016; Mbabazi Moyo et al., 2015).

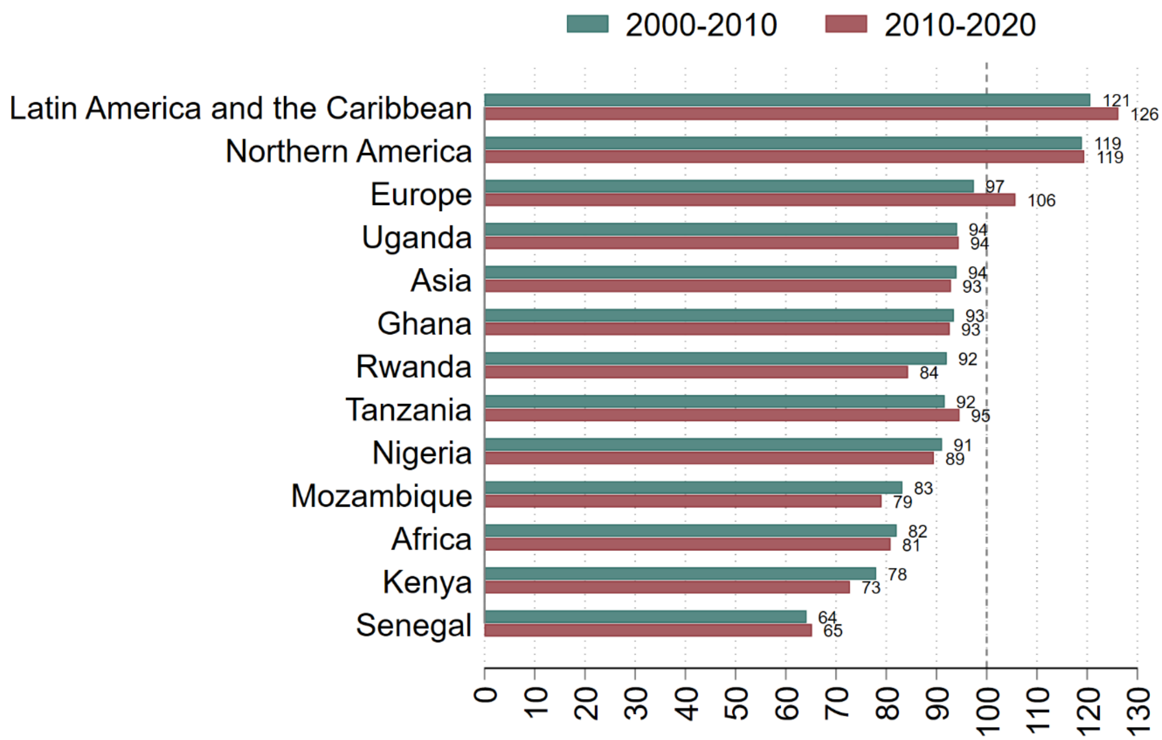
Figure 10: Food self-sufficiency trends in the world, 1961–2019



Source: Author's calculations using FAOSTAT (2023) data.

FSSRs in the eight target countries show that none of the countries is self-sufficient (Figure 11). However, apart from Senegal and Kenya, the other six countries present FSSRs above the continental average. The ratios for Rwanda, Nigeria, Mozambique, and Kenya all decreased between the two periods, while they increased slightly for Tanzania and Senegal. The situation of Africa as a whole and its exposure to global shocks continue to raise legitimate concerns in the context of current crises (the COVID-19 pandemic, Russia-Ukraine war, and others).

Figure 11: Food self-sufficiency ratio in the target countries and benchmark regions



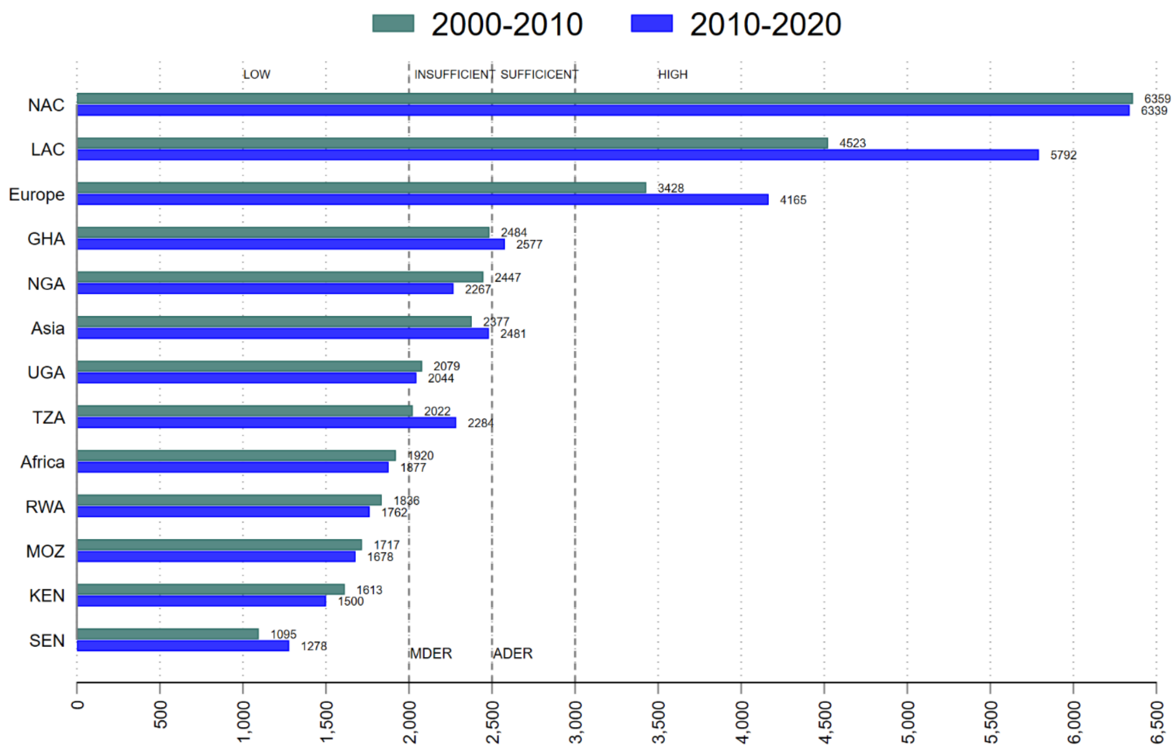
Source: Author's calculations using FAOSTAT (2023) data.

Dietary energy production per capita

Food self-sufficiency can also be measured in terms of a country's dietary energy production (DEP) per capita compared to the dietary energy requirement. Countries that produce 2500 kcal per capita per day (kcal/cap/day) or more are typically considered to be self-sufficient, as consumption of at least this quantity of calories per day is seen by most nutritionists to be necessary to ensure an adequate diet (Porkka et al., 2013). Porkka et al. (2013) consider that a country that produces between 2000 and 2500 kcal of food as "insufficient", less than 2000 kcal as "low", and higher than 2500 as "high." As it excludes imports, this indicator does not refer to the dietary energy supply and does not consider the capacity of domestic production to cover the domestic demand.

Figure 12 presents average DEPs for the 2000–2010 and 2010–2020 periods. Using the scale from Pokka et al. (2013), the Africa region's food self-sufficiency is considered low and, except Ghana over the 2010–2020 period, the focus countries do not meet the dietary energy requirements to be self-sufficient in either period. These results confirm those found in **Figure 11**.

Figure 12: Dietary energy production per capita (DEP; kcal/cap/day)



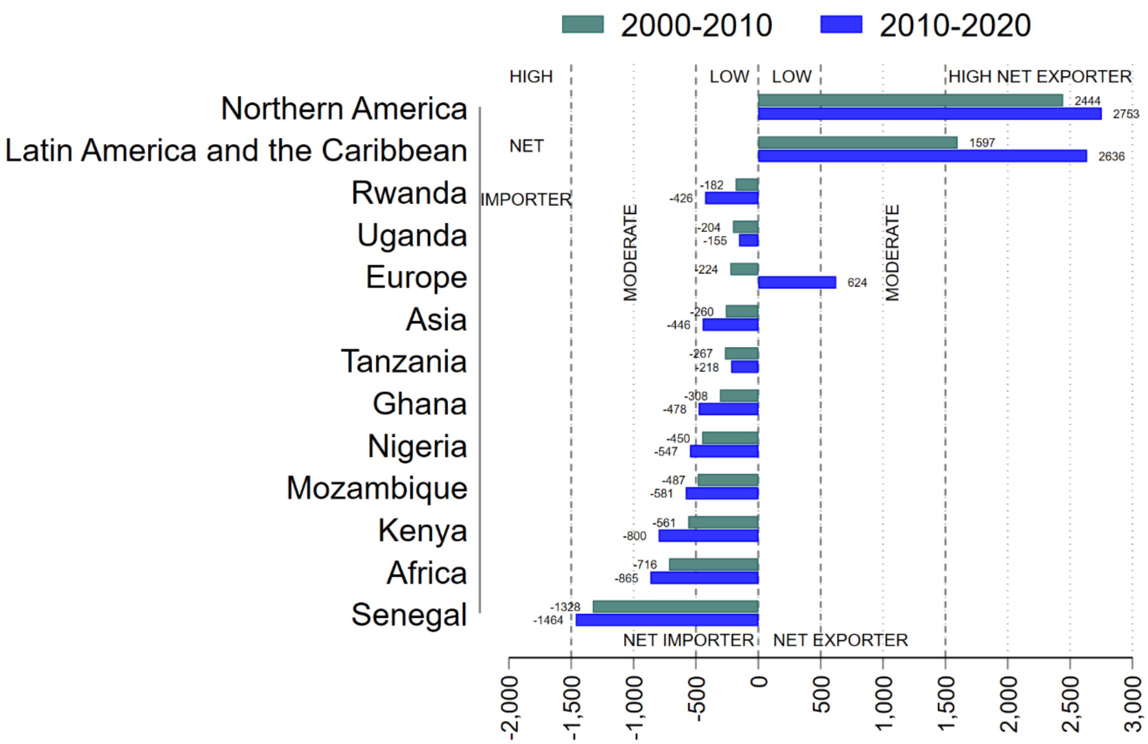
Source: Author's calculations using FAOSTAT (2023) data

Trade balance in calories

International trade plays a key role in meeting domestic demand and makes it possible to sell some domestic supply. The position of a country as a net exporter or a net importer and its dependency on imports or exports is crucial to determining its exposure to world markets. The net trade position (NTP) in kcal/capita/day therefore provides another indicator of food self-sufficiency. The NTP considered here includes all traded agricultural products in terms of calories. Following (Porkka et al., 2013), a country is considered a high net importer when its NTP belower −1500; a moderate net importer when NTP is between −1500 and −500, inclusive; a low net importer when NTP is between −500 and 0; a low net exporter when NTP is between 0 and 500; a moderate net exporter when NTP is between 500 and 1500; and a high net exporter when NTP is greater than1500. The thresholds of 500 and 1500 kcal/capita/day correspond to 20% and 60% of global ADER respectively. This means that a country with high net exports (over 1500 kcal/capita/day) could, at least in theory, provide over 60% of the ADER of a nation of equal population. It is important to keep in mind that the trade data do not cover informal cross-border trade, which is quite substantial in Africa.

As shown in Figure 13, Africa was a moderate net importer (that is, not self-sufficient)[3] on average over the 2000–2010 period, and the situation did not change substantially in the 2010–2020 period. Over the entire 2000–2020 period, Senegal remained the most exposed country among the focus countries. Rwanda, Uganda, Tanzania, and Ghana are low net importers, and Mozambique and Kenya are moderate net importers. In addition, the net trade position of Nigeria has not significantly changed but shifted from low net importer in the 2000-2010 period to moderate net importer in the 2010-2020 period. Africa as a continent is still the region most exposed to world market disruptions and remained a moderate net importer over the 2000–2020 period.

Figure 13: Net trade position (kcal/capita/day)



Source: Author's calculations using FAOSTAT (2023) data.

[3] Considering 2500 as the ADER, net trade imports cover 40% of the ADER.

AGRICULTURAL SUPPORT AND PROTECTIONISM IN AFRICA

Background

In this section, we present an overview of agricultural support and protection measures and policies in Africa, with particular attention to border protection measures (mainly trade policy instruments). These are often used because of their low budgetary cost.

Table 2 presents the impact of different trade policy instruments on economic variables that may affect food security: import duties; import subsidies): import quotas (or even prohibition); export subsidies or taxation; and quantitative restrictions (or even prohibitions) of exports.

When a national government applies an import duty, the local price of the imported good increases, consumption of this good decreases, and local production of this good increases. The import duty also increases the government's revenue and contributes to a fall in the world price of this good (since it reduces global demand for this good), especially if this country is large. We can therefore conclude that a duty on the import of an agricultural or food good adversely affects the food security of a country, particularly because it increases the price of this agricultural good or food and reduces its consumption. However, it should be noted that such a tariff can protect local farmers from international competition and thus increase their income. By increasing government revenues, it can also increase a government's ability to finance national infrastructure. Finally, by lowering the world price of an agricultural good traded on the world market, it can improve the terms of trade of countries importing that agricultural good or food. An import quota has the same effects, but its impact on government revenue is uncertain because it may or may not generate government revenue depending on how and to whom import licenses are sold.

Table 2: Short-term impact of various trade policy instruments on prices, surpluses, and public revenues

Policy instrument	Impact on local price	Impact on local consumption	Impact on local production	Impact on public revenues	Impact on world price
Import duty	+	–	+	+	–
Import quota	+	–	+	?	–
Import subsidy	–	+	–	–	+
Export subsidy	+	–	+	–	–
Export tax	–	+	–	+	+
Export restriction	–	+	–	?	+

Source: Bouët and Laborde, 2017.

If a government subsidizes imports of an agricultural or food good, the domestic price of that good will decrease and the local consumption of that good will increase, which contributes positively to the country's food security. However, local production of this good will decline, which hurts local farmers, and subsidies have a negative impact on government revenues. By increasing global demand, subsidies are expected to increase the world price of this good.

Turning to exports, if a national government subsidizes exports of an agricultural or food good, the supply of this good on the domestic market will decrease, contributing to an increase in its price and a decrease in its consumption. An export subsidy therefore negatively affects the country's food security. It also has a negative impact on government budget. However, domestic producers receive the subsidy and thus increase the production of this good, in particular in order to increase exports: this has a positive impact on their income. Finally, by increasing the supply of the good on world markets, an export subsidy reduces the world price of that good, especially if the country is large.

An export tax is, however, an instrument that improves the country's food security. Applied to exports of an agricultural or food good, a tax redirects the national supply to the local market and thus reduces the price of this good in the domestic market, thus increasing its consumption. Taxing the domestic farmers reduces their production of the good, a larger part of which is sold locally, and their income is negatively affected. Government revenues rise, as does the world price of this good. An export quota has the same impacts, except for its uncertain impact on government revenues, which it may or may not increase depending on how and to whom export licenses are sold. Taxes or export restrictions are instruments often used by governments to improve national food security. However, these "beggar-thy-neighbor" non-cooperative policies, often implemented during crises, do significant harm to importing countries and jeopardize their food security.

On the other hand, a subsidy for local production of an agricultural or food good implicitly subsidizes consumption and exports by reducing production costs, and consequently the domestic price of the good, leading to increased food security and the protection of farmers' income from international competition. However, this policy tends to reduce the world price. The reduction in the world price may lead to improved food security globally but may have an adverse effect on countries that have comparative advantages in these products. For example, domestic agricultural support programs in rich countries can have long-term negative effects on real income and food security in low-income countries.

What about the impact of these policies on food self-sufficiency? Policies that increase national production, ceteris paribus, strengthen a country's self-sufficiency. The imposition of tariffs or quantitative restrictions on agricultural and food imports are therefore policies that support a country's self-sufficiency. An export subsidy supports local production, but it also supports exports; its impact on self-sufficiency is therefore ambiguous. It should be noted, however, that the Common Agricultural Policy (CAP) set up by the European Economic Community in the 1960s had food self-sufficiency as its explicit objective and liberally applied both import duties and export subsidies.

Government interventions, agricultural support, and food self-sufficiency

Between 1950 and 2000, protectionist agricultural policies were introduced in Africa, with the aim of achieving food self-sufficiency. As in Latin America, import substitution strategies were also implemented in Africa. Import substitution policies favor industrialization, and finance industrial development through a tax on agriculture (Timmer, 1991).Europe's CAP served as a model for many African countries, which implemented protectionist policies aimed at self-sufficiency, mainly in the form of customs duties (Balié and Fouilleux, 2008). However, beginning in the 1980s, the proliferation of structural adjustment plans has promoted trade liberalization policies.

Implementing protectionist agricultural policies in poor countries is *a priori* counterintuitive. These policies lead to an increase in domestic agricultural prices, which has significant negative effects on the purchasing power of a population that spends a significant part of its budget on food. But these policies have two positive effects for governments. On the one hand, they help to garner the support of farmers, who benefit from protection from international competition. On the other hand, they provide government revenues in countries where the tax bases are small. As such, major export products, such as coffee and cocoa, may be subject to export taxes to obtain public revenue.

An argument often used to justify protectionist agricultural policies is that they shield the agricultural sector and local consumers from price fluctuations in world markets. MacDonald (2013), for example, highlights the increasing concentration of supply of certain important agricultural commodities (cereals, vegetable oils) combined with the growing dependence of some developing countries on external supplies that together may increase the vulnerability of these countries. However, this argument can be directed to domestic markets too. That is, strengthening self-sufficiency through protectionist policies increases the importance of domestic agriculture in supplying the local market, increasing the potential for shocks (climatic for example) to local agricultural production to cause even more volatility in local prices. The debate today is no longer about free trade versus protectionism, but rather about the best strategies for increasing the resilience of food supplies to local populations. Strategies to diversify supplies are then put forward, combining openness to international trade and support for local production.

Agricultural border protection in Africa and in the world

Agricultural protection refers to the protection of farmers and the agricultural sector from international competition. There are two different approaches. In the early stages of economic development, a country may opt to impose "negative" policies such as taxation of agricultural products imported from the rest of the world. The other option is to adopt "positive" policies to support the agricultural sector as the economy develops (Honma, 2019). These opposite approaches to reach the same goal are named the “developmental paradox” by De Gorter and Swinnen (2002).

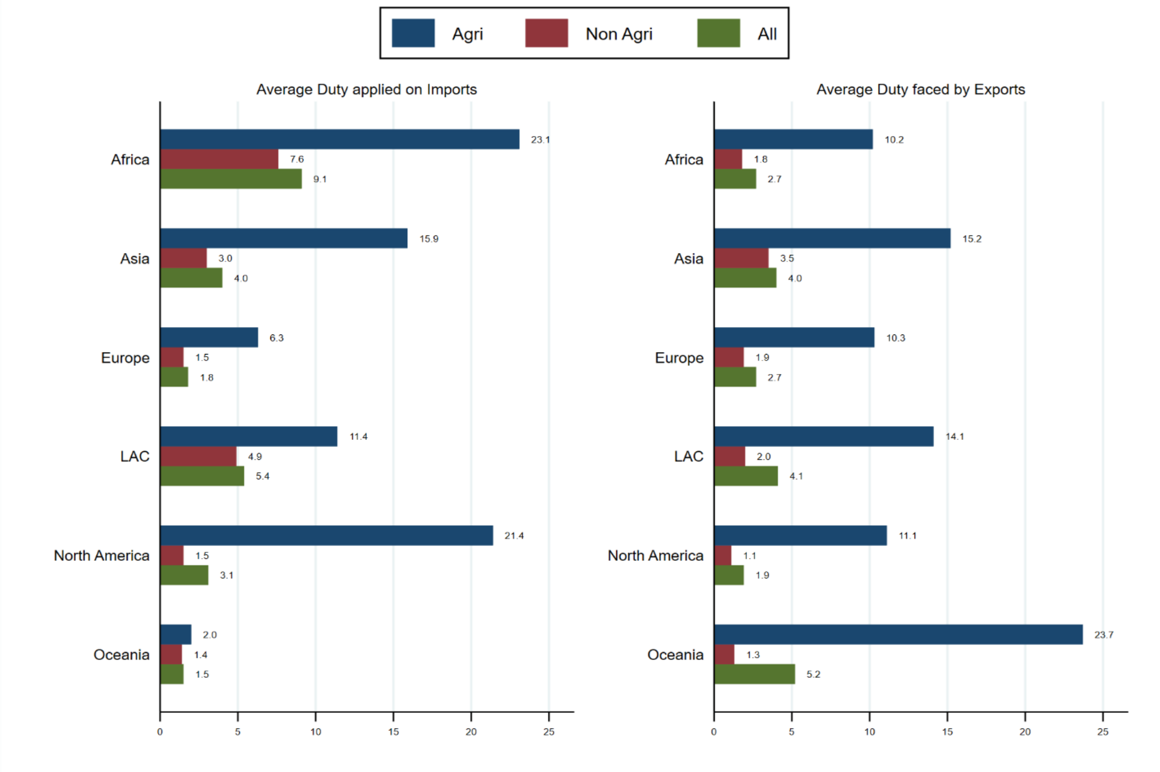
This section analyzes agricultural protectionism in Africa in terms of products and countries, as well as Africa’s position vis-à-vis the rest of the world. We look at two indicators: *average duties applied on imports* measures protection levels in terms of tariff duties applied by each country, region, or continent on its imports at its own borders; *average duties faced by exports* measures protection in terms of tariff faced by the exports of each country, region, or continent when these exports enter the territory of trading partners.

At the world level, the average duty applied on all products is relatively low (about 3.45%), although the average tariff is higher for agricultural products than for non-agricultural products (12.98% vs. 2.64%). Figure 14 shows the levels of average duties applied on imports and faced by exports for Africa, Asia, Europe, North America, and Latin America and Caribbean (LAC) for all products and separately for agricultural and non-agricultural products. The results show that Africa has the highest import tariffs relative to all continents and for all products (9.1%), and non-agricultural products (7.6%), and imposes particularly high tariffs on imports of agricultural products (23.1%).

In terms of average duties faced by exports, the African average is 2.7% for all goods compared to 4.0% for exports from Asia and 5.2% for exports from Oceania, which faces the highest average tariffs. For non-agricultural products, the African average is 1.8% compared to 4.1% for Asia and 5.2% for Oceania. For agriculture, the African average is 10.2% compared to 15.2% for Asia and 23.7% for Oceania, which aces the highest tariffs on its agricultural exports. Oceania's main exports are dairy products, cereals, and meat, all products that are highly taxed worldwide, and countries like Australia and New Zealand have not been granted any preferential terms.

Concerning Africa, tariffs faced by the continent’s exports are lower than duties applied on its imports. This is due both to trade preferences granted to African exporters and to the type of products they export.

Figure 14: Average duties applied on imports and faced by exports by continent, 2019



Source: MAcMap-HS6 2019, authors' calculation.
Note: LAC: Latin America and the Caribbean.

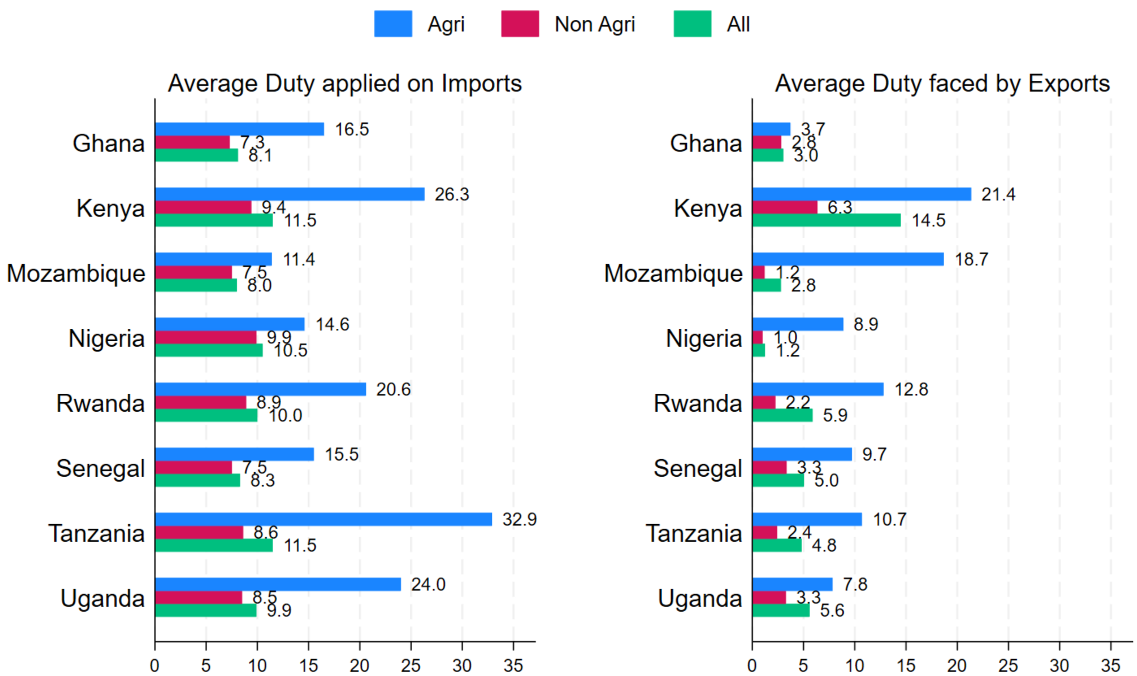
Figure 15 shows average duties applied on imports and faced by exports in the eight focus countries for all products, agricultural products, and non-agricultural products in 2019. The average duty applied on imports for all products varies from 8.0% in Mozambique to 11.5% in Kenya, and rates for non-agricultural products are similar for all eight countries, around 8%. For agricultural products, tariffs vary much more, ranging from 11.4% for Mozambique to 32.9% for Tanzania. However, the three countries that are members of the Economic Community of Wester African States (ECOWAS)—Ghana, Nigeria, and Senegal—all have tariffs of about 15%. In sum, import tariffs in the agricultural sector are still very high in the target countries, as they are for continental Africa, but a high level of harmonization already exists at the regional level, for example, in ECOWAS.

For all products, tariffs faced by exports are highest for Kenya (14.5%), followed by Rwanda (5.9%). In contrast, Ghana (3.0%) and Nigeria (1.2%) face the lowest tariffs on exports, if we consider all products. These two countries largely export oil, gas, and mineral products, which are usually not taxed (or only slightly) at the border. Moreover, these countries have been granted preferential regimes.

For agricultural products, the average duty faced by exports in Ghana (3.7%) is the lowest, followed by Uganda (7.8 %) and Nigeria (8.9%). In contrast, Kenya (21.4%) faces the highest tariff rate among the eight target countries followed by Mozambique (18.7%) and Rwanda (12.8%).

For non-agricultural products, the average duty faced by exports varies between 1% (Nigeria) and 6.3% (Kenya). Thus, compared to import tariffs, export tariffs are lower. Indeed, many African countries benefit from preferential regimes, especially with the EU through the Everything But Arms initiative and with the United States through the African Growth and Opportunity Act. In addition, African countries' exports are primarily energy and mineral products (oil and gas), which benefit from low import duties worldwide.

Figure 15: Average duties applied on imports and faced by exports, Africa in 2019



Source: MAcMap-HS6 HS6 2019, authors' calculations.

Agricultural support in Africa and the world

It is important to keep in mind that governments can influence agricultural support or protection using a wide range of instruments affecting inputs as well as outputs. Subsidies, controls over land use, producer and consumer price support, taxes, and food reserves are the main instruments that can directly contribute to agricultural support or protection. Moreover, as previously shown, trade policies such as tariff measures and nontariff measures (quantitative restrictions) also affect agricultural support or protection. As highlighted by Mamun et al. (2021), support to and taxation of agriculture come in many forms, but it is useful to distinguish three main forms of support: (1) market price support, (2) coupled subsidies, and (3) decoupled subsidies. Governments generate market price support by introducing barriers to trade such as tariffs, licenses, and quotas that raise (or lower) the domestic price of a product relative to world prices. Coupled subsidies include measures such as subsidies to outputs or inputs that increase the returns to producers and hence their incentive to produce specific goods. Decoupled subsidies base payments on something fixed, such as production in a prior period and thus remove the link between support and current output levels.

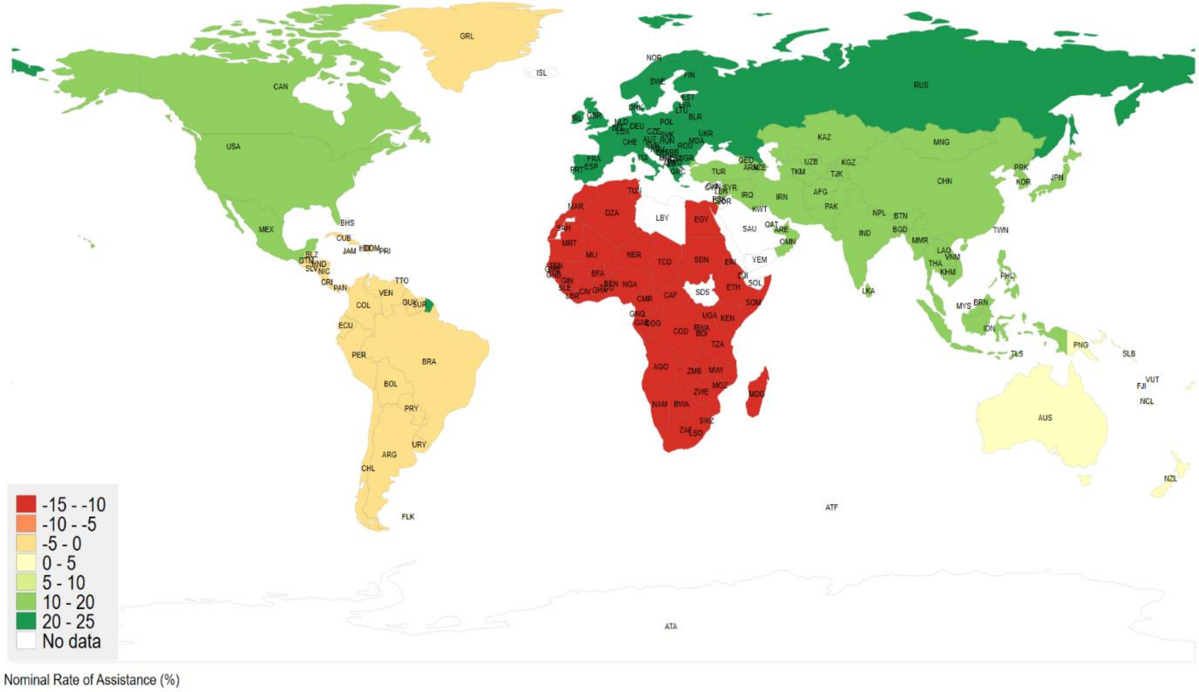
As indicators of protection or support to agriculture, we use the *nominal rate of protection* (NRP) and the *nominal rate of assistance* (NRA). Both are relevant for analyzing the impact of trade and domestic policies on the difference noted between domestic and international prices.

The NRP is simply the price gap between the domestic price and the reference price (absent tariffs) as a share of the reference price. NRP can be measured at the various levels of the value chain, from farmgate to point of consumption. It captures the level of price incentives/disincentives to the agents in the value chain, and thus the effects, in relative terms, of the policies and market performance. A positive NRP shows that the policy and market environment provide price incentives to the agents (producers or middlemen); a negative NRP signals that farmers face price disincentives, receiving a price below the reference price.

The NRA is defined as the percentage by which national government policies raise or lower gross returns to farmers above (NRA>0) or below (NRA<0) what they would be without government intervention (see Anderson et al., 2008 for methodological details). NRA is an extension of the NRP that takes into account subsidies or/and budget transfers allocated to the producers of a given commodity. The NRA is only computed at the farmgate level. This measure captures (dis)incentives to the production of a given product arising from trade and market policies, subsidies, and market functioning.

The distribution of NRAs over the period 2010–2020 varies across regions, with higher NRAs in developed countries and very low NRAs in developing countries, especially in Africa (see Figure 16). Over the last decade, the NRA in Africa has been the lowest in the world, meaning that Africa’s agricultural sector iis not substantially supported and globally taxed.

Figure 16: Nominal rate of assistance, 2010–2020 (%)

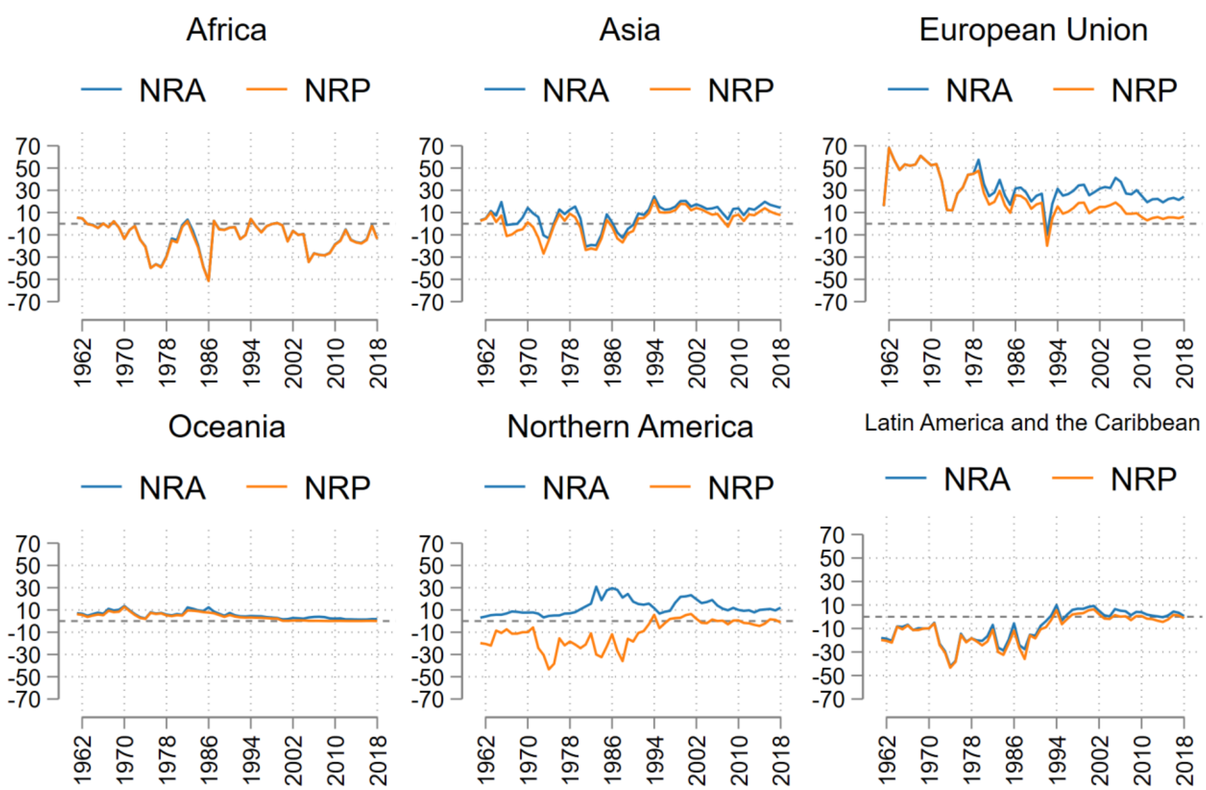


Source: Ag-Incentives database.

Figure 17 presents the NRA in Africa, with the other regions serving as benchmarks, and compares it with the NRP, which expresses the percent of support that comes through country's trade policies such as import tariffs and export taxes. In Africa, the NRA and NRP are almost the same (superimposed lines in the figure) and were negative over the period. This result shows that, overall, Africa does not protect the agricultural sector and the level of support (subsidies, public transfers to producers, etc.) to the sector is very low. The same trend (absence of difference between the NRA and the NRP) is observed in Oceania and Latin America and the Caribbean. In the European Union, Asia, and North America, we observe a positive NRA and NRP, and the NRA is always higher than NRP, meaning that outside of tariff measures, these regions also support the agricultural sector through budgetary transfers (subsidies and income support for example).

It is worth noting that NRAs are low in LAC, partly due to the fact that large countries (Brazil, Argentina) in this region have substantial export taxes and other measures that lower domestic prices compared to international or reference prices at the aggregate level.

Figure 17: NRA vs. NRP by region

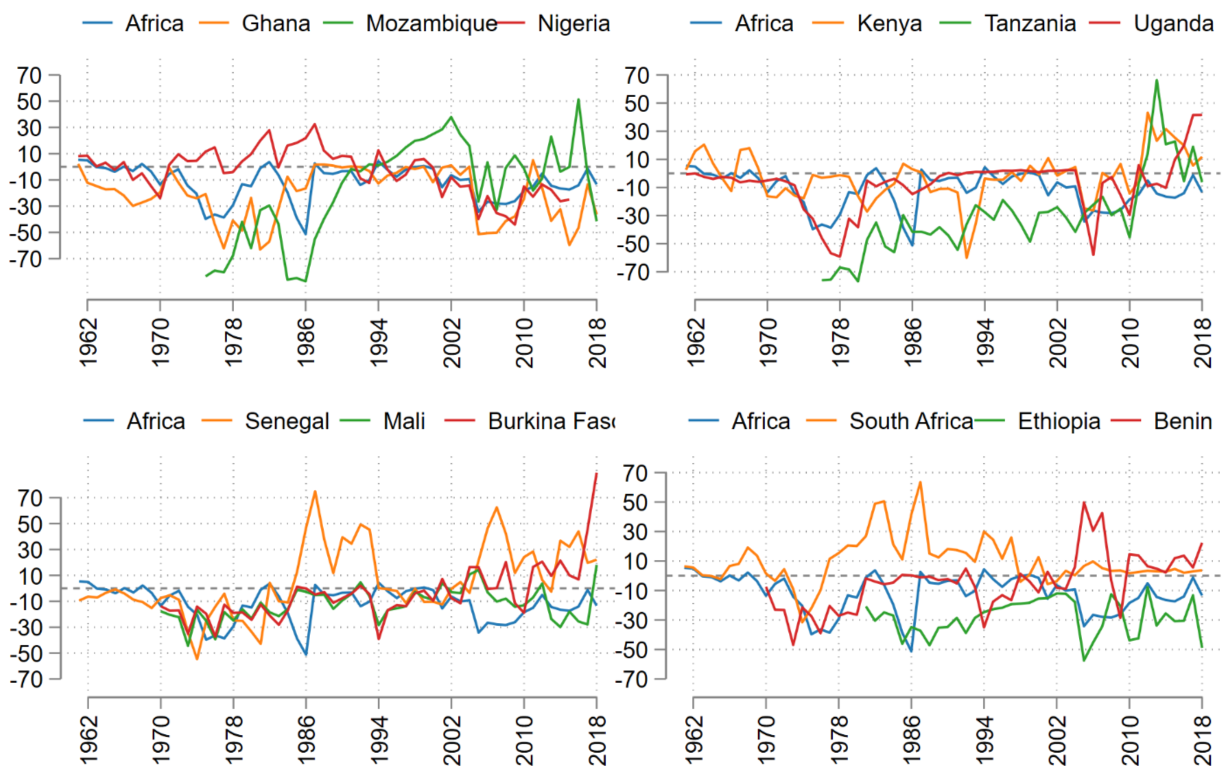


Source: Ag-Incentives database (2022).

Figure 18 highlights the NRA (obtained from the Ag-Incentives database) in African countries.At the continental level, Africa's NRA is negative, meaning that the agricultural sector is taxed. However, for the 12

African countries available in the Ag-Incentive database from 1960 to 2018, the trend is mixed. Countries including South Africa, Senegal, Mozambique, and Burkina Faso sometimes support their agricultural sector. Apart from these countries, the agricultural sector is barely supported in Africa. Since the figures presented here are aggregated across commodities and countries, it is worth noting that high import tariffs in some sectors can be offset by high export taxes in others, resulting in a negative NRP and NRA.

Figure 18: NRA in Africa



Source: Ag-Incentives database.

Agricultural support in Africa remains very low despite the use of import tariffs to protect the sector from world markets. Following the Maputo Declaration (2003) and the later Malabo Declaration (2014), African countries made commitments and adopted policies, and regulations to support agriculture for food security and intraregional trade. The African Union Assembly held in Malabo in 2014 made agriculture as the backbone of the 2025 agenda. The Assembly recommitted to the CAADP principles and goals and defined a set of targets and goals, namely the Accelerated Agricultural Growth and Transformation Goals 2025. Across the seven commitments of the Malabo Declaration, most targets directly concern the agricultural sector. Governments committed to upholding the goal of directing 10% of public spending to agriculture. Overall, African RECs are not on track to reach the goal. In the ECOWAS region, for instance, only 3 of the member 15 countries have reached the Malabo target over the last 10 years (Regional

Strategic Analysis and Knowledge Support System (ReSAKSS) data.[4] Therefore, efforts are still needed to support the agricultural sector in Africa.

IMPACT OF AGRICULTURAL SUPPORT ON FOOD SELF-SUFFICIENCY AND FOOD SECURITY

Literature review

It is well established that free trade policies allow economies to develop their optimal comparative advantages, which can increase per capita income, long-term growth rates, and their capacity to achieve food security. Despite these advantages of free trade, governments continue to intervene in ways that distort trade. From taxation to domestic protection, governments intervene either to mitigate the effects of short-run food crises or to promote food self-sufficiency.

However, a wide range of tools have been developed to provide insights about the impact of taxation and protection measures on the levels of food security and food self-sufficiency. Therefore, the long-standing debate on whether food self-sufficiency is a useful strategy to achieve food security (Minot and Pelijor, 2010) has been renewed among policymakers and academics who favor protection measures for food self-sufficiency and those who argue that complete market liberalization is the best approach to achieving food security.

In this subsection, we provide an empirical review on the factors that influence the level of agricultural trade protection, the impacts of agricultural incentives and disincentives on food self-sufficiency and food security, and the link between food self-sufficiency and food security.

Agricultural protection policies are far from exogenously determined by governments. The level of protection and the level of economic development of a country generally move together but may move in different directions. Several theorical contributions identify the factors that affect the level of agricultural protection. Olson (1965) used the theory of collective action to explain the introduction of protectionist policies in agriculture. Similarly, de Janvry (1983) developed the theory of special interest that understands the government as acting for its own benefit. Gorter and Tsur (1991) introduced a model of voters–politicians interaction to explain some observed patterns of government intervention in agriculture.

Empirical evidence shows several explanatory variables that determine the level of agricultural protection. Among these variables, the most cited are the comparative advantage of agriculture, the terms of trade in international markets, the share of agriculture in GDP, the rural share of the population, the GDP per capita of the rural population, the relative rural–urban income differential, relative labor productivity,

[4] https://www.resakss.org/

and institutional factors (quality, transparency, political regimes, lobbying, etc.). These factors affect the level of protection in agriculture in different ways. Indeed, agricultural protection increases in countries with a comparative disadvantage in agriculture, while protection rises when the terms of trade decrease (Honma and Hayami, 1986). Moreover, agriculture is generally taxed in developing economies, but policies shift toward protection as the economy develops. As the average GDP per capita grows over time, the level of protection in agriculture increases, (Swinnen et al., 1999). This phenomenon is the so-called "developmental paradox" (De Gorter and Swinnen, 2002). Honma (2019) shed light on this paradox, emphasizing that in the early stages of economic development, agriculture is the biggest industry and employs a large workforce. As the economy develops, the agricultural sector shrinks in relative terms, the agricultural labor force also declines, taxation decreases, and protection increases. This phenomenon is best explained by de Janvry's (1983) theory of special interest and Olson's (1965) theory of collective action. As the number of farmers in the agricultural sector declines, lobbying against agricultural taxation can be conducted more efficiently and, if their number declines further, farmers succeed in promoting protection policies. In the same vein, agricultural protection is negatively related to the relative size of the agricultural sector as measured by number of farmers (share of rural population).

Institutional factors that influence agricultural protection are well developed in the literature, but mixed results have been found. According to Olper (2001), democracy affects agricultural protection positively, but it is not the level of democracy per se that matters. Olper, Falkowski, and Swinnen (2014) found similar results by performing a quasi-experimental method (both difference-in-differences regressions and semi-parametric matching methods). They found a significant positive (negative) effect of a democratic transition on agricultural protection (taxation). Moreover, the quality of institutions that protect and enforce property rights is a key determinant of agricultural protection. In the same vein, Bates and Block (2009) analyzed the effects of three factors (institutions, regional inequality, and the tax revenue generation) affecting agricultural protection, and highlighted lobbying and voting, which can impact the decisions of governments. The results from Bates and Block (2009) show that the absence of electoral party competition attenuates the effect of the rural population share on agricultural taxation. On the other hand, party competition decreases the effect of lobbying on agricultural protection. In addition, rich regions tax more export producers and protect consumers.

Other factors influence agricultural protection policies. Studies show that information plays a crucial role in political markets, organization, and policy design. In the empirical review, the use of information may be presented in different forms, from improvement of rural communication infrastructure to the use of commercial mass media to influence policy design. Olper and Swinnen (2009) argue that mass media will increasingly weaken the political power of small groups. Another key issue is the power of international financial institutions (such as the World Bank and the International Monetary Fund) and regional economic communities (RECs) to impose their conditionality. The structural adjustment programs in Africa and Latin America in the 1980s constitute an example of such a power.

Over the last decades, governments have constantly applied tariff and non-tariffs measures, as well as domestic measures to support producers to promote food self-sufficiency and the development of the agricultural sector. However, there is a popular belief about building a bridge between food security and food self-sufficiency, the latter implying the former. Is food self-sufficiency necessary or sufficient for achieving food security? This tricky question has received different answers. The theorical analysis and the observed trends in most countries show that the link between food security and food self-sufficiency is not direct. As previously mentioned, food security for a country means the capacity of people to be able to get adequate, sufficient, and stable food wherever it comes from while food self-sufficiency just means the ability to grow all the food needed at home. Baer-Nawrocka and Sadowski (2019) look at te food production potential of a cluster of countries and the resulting food security levels. They show that the degree to which food security is ensured by domestic supply varies greatly across the globe. Domestic supply may be the foundation for food security in the developed countries with favorable conditions for agriculture (North America, Australia, New Zealand, Kazakhstan). Yet, wealthy countries characterized by a high level of productivity and a relatively small arable land area per capita also may develop a high level of food security (mainly European countries). However, free trade also contributes to food security in Middle East and North African countries as well as in some South American countries. Sub-Saharan African and Central Asian countries still face problems achieving food security in the context of international trade exposure. These results show that the relation between food security and food self-sufficiency is both complex and unclear.

Few empirical studies focus on the link between agricultural protection policies and food security or food self-sufficiency. Magrini et al. (2017) show that agricultural (dis)incentives matter and that their impact on food security varies in a nonlinear way with the level of intensity. First, the taxation of the agricultural sector has a negative impact on the four pillars of food security. Second, countries that provide moderate support to agriculture improve their food security pillars. The first result confirms with those from Anderson, Rausser, and Swinnen (2013), who show that that taxation impedes both consumers and producers to improve their welfare. The second result points out that too much support for producers comes at the cost of aggregate food security performance, which might counterbalance the initial benefits or be more damaging than taxation. This is often true when countries use support to producers to tackle shocks and improve their food self-sufficiency to reduce impact of food crisis. This leads to oversupply and accumulation of stocks at prices that do not reflect the market equilibrium. Although the above-mentioned studies provide interesting insights, it appears that they did not focus on the link between agricultural protection and food self-sufficiency, or between food self-sufficiency and food security.

Methodology and data

Methodology

A wide range of studies have examined the links between food security or food self-sufficiency and policy interventions (e.g., Smith, 1998; Diaz-Bonilla et al., 2002; Anderson and Nelgen 2011; Huchet Bourdon and Laroche Dupraz, 2014); Magrini et al. 2014). To the best of our knowledge, they all estimate a homogenous impact. Yet there is no reason to believe that the impact of policy interventions is homogenous across the entire distribution of the dependent variables (food-self-sufficiency or food security). Therefore, to avoid this restriction and to allow heterogeneity in the response of food self-sufficiency to agricultural support, we use a quantile regression approach. To capture food self-sufficiency, we use the food self-sufficiency ratio, defined as the ratio between the dietary energy production (DEP) and the dietary energy supply (DES). The nominal rate of assistance is used to measure agricultural protection and support policies.

We consider the following panel data regression model with endogenous independent variables:

$$FSSR_{it} = Z'_{it}\delta(U_{it}) + X'_{it}\beta(U_{it}) + D_{it}\alpha_i(U_{it}) \quad U_{it}|Z'_{it}, X'_{it}, D_{it} \sim U(0,1)$$

$$\tau = Z'_{it}\delta(\tau) + X'_{it}\beta(\tau) + D_{it}\alpha_i(\tau)$$

$$Z_{it} = h(X_{it}, W_{it}, V_{it})$$

where FSSR (food self-sufficiency ratio) is the response variable for country i at time t, Z is a vector of endogenous variables (NRA, NRA^2), X is a vector of exogenous variables, and u is the error term, W is a vector of instrumental variables, D is a vector of dummy variables for the individual effects, and τ is the τ^{th} quantile of the conditional distribution of FSSR.

Estimating δ at different quantiles of the conditional distribution of FSSR, provides an opportunity for investigating how the NRA (agricultural protection and support policies) impacts the location, scale, and shape of the distribution of food self-sufficiency.

The main objective is to examine the way the level and intensity of the agricultural protection and support policies affect the conditional distribution of the food self-sufficiency ratio, as well as how the level of development affects the impact of agricultural protection policies. However, it is important to consider the risk of potential endogeneity related to the reverse causality between food self-sufficiency and agricultural protection and support policies. To this end, we perform a quantile regression with endogenous bias treatment.

Endogeneity bias is a tricky problem to deal with, and the cure can be worse than the disease, as pointed out by Bound, Jaeger, and Baker (1993; 1995). If not considered, it yields inconsistent estimates and misleading conclusions. Here, we propose an instrumental variables (IV) technique to deal with the endogeneity of agricultural support. We use the lagged value of the suspected variable as the instrument, one of the most commonly used approaches. More precisely, we use the previous decade's simple moving average of NRA, which is assumed to be correlated with the current level of NRA but weakly correlated with any other determinants of food self-sufficiency.[5]

Another tricky problem that we may face here is the presence of the square of the endogenous variable as an independent variable. A common mistake is to substitute the fitted value of the endogenous variable inside the nonlinear function (the square of the endogenous variable). As pointed out by Wooldridge (2002), this approach does not guarantee the absence of bias. Rather, the estimated square of the predicted value of the endogenous variable should be used as an instrument of the square of the endogenous variable. This approach is adopted here. For ease of the interpretation of the results, we use the logarithm of the variables (affected by units) so that the coefficients represent elasticities.

Data

The data used in this study come from various sources and cover the 1990–2018 period. Food security, and food self-sufficiency indicators come (or are estimated) from the FAOSTAT database. The food availability indicator used is the food supply (kcal/capita) available in the food balance sheets database. The food access indicator used is the prevalence of undernourishment. The percentage of children under five who are stunted and the prevalence of anemia among women of reproductive age are used as food utilization indicators. For the last pillar of food security, we use the food price volatility indicator to measure food stability. This indicator is based on the growth rate of the consumer food price index. It is available from 1990 to 2018. In the same vein, we use the food self-sufficiency ratio, not directly available from the FAOSTAT database, but estimated from the food balance sheets database. We adopted a robust approach to estimate the conversion rates from quantities to calories for each product, to estimate the food self-sufficiency ratio for each country as the ratio between the DEP and the DES. The FSSR is available for 101 countries from 1990 to 2018.

We used the NRA as the indicator of protection or support to agriculture, defined as the percentage by which national government policies raise or lower gross returns to farmers above (NRA>0) or below (NRA<0) what they would be without government's intervention—or lower them, (see Anderson et al. (2008) for methodological details). The NRA data are available from 1961 to 2018 and come from the Ag-Incentives Consortium database of IFPRI. In fact, two sources (Distortions to Agriculture Incentives (DAI) database and Ag-Incentives Consortium database) are available to the user and policy analyst. The Distortions to Agriculture Incentives (DAI) database, a World Bank research project, is a core database of NRA for producers and other indicators aiming to measure the effectiveness of trade and agricultural policies. The DAI database, updated by Anderson and Nelgen (2013), covers 82 countries (45 developing countries, 13 European transition economies, and 24 high income countries) from 1955 to

[5] See Magrini et al. (2017) for a similar approach.

2011, and 75 agricultural products. For data coverage up to 2018, the Ag-Incentives Consortium database presents NRA data from 2005 to 2018. This later initiative released in 2013 brings together information on agricultural incentives from five key institutions: FAO (MAFAP), the Inter-American Development Bank (IADB), IFPRI, the OECD, and the World Bank. To ensure data consistency, IFPRI provides long time series on NRA in the agricultural sector (at aggregate level) by harmonizing the two databases[6]. The harmonized database provided by IFPRI includes 42 countries/regions (11 in Africa and 31 outside of Africa) from 1961 to 2018. In this database, EU is treated as one region.[7]

Other indicators (GDP/capita, inflation, terms of trade, population density, share of rural population in total population, share of agriculture value added in GDP), used as exogenous variables, come from the World Development Indicator database. The arable land per capita data are an estimation of the arable land from the FAOSTAT database divided by the total population from the World Development Indicator (WDI) database. These variables are presented in the Table 3.

We also include women's participation in the agricultural sector as an explanatory variable. Women's participation varies considerably across regions; it is very high in developing countries and very low in developed countries. In Africa, women comprise 50 to 60 percent of the agricultural labor force, with substantial heterogeneity across countries—about 80 percent in Rwanda and 30 percent in Nigeria (see Figure 19). As in the general population, the participation of women in the agricultural sector decreased over the past two decades. However, the share of women in the agricultural sector does not show a clear pattern on their contribution to food production. Although women may have a very high participation rate in the agricultural sector in developing countries, they work mainly on very small-scale units, mostly self-employed or with some assistance from family members or hired workers, whose income-generating activities are not registered, recognized, or regulated by the government (FAO, IFAD, and ILO, 2010). Moreover, in sub-Saharan Africa, women are overrepresented in unpaid, seasonal, and part-time work, and often paid less than men for the same work (SOFA, 2011). The rules established for the participation of women in the agricultural sector depend on multiple factors. In most cultures, women are responsible for most of the household and child-rearing activities as well as specific activities in agriculture, livestock, and fishery.

The expected sign of the participation variable is uncertain. On the one hand, limited participation of women can represent a non-optimal use of resources and comparative advantages, thus a deviation from what would be a Pareto optimal situation.[8] On the other hand, when they do participate, they are entitled to plots of land with relatively low productivity and face many constraints that impede their contribution,

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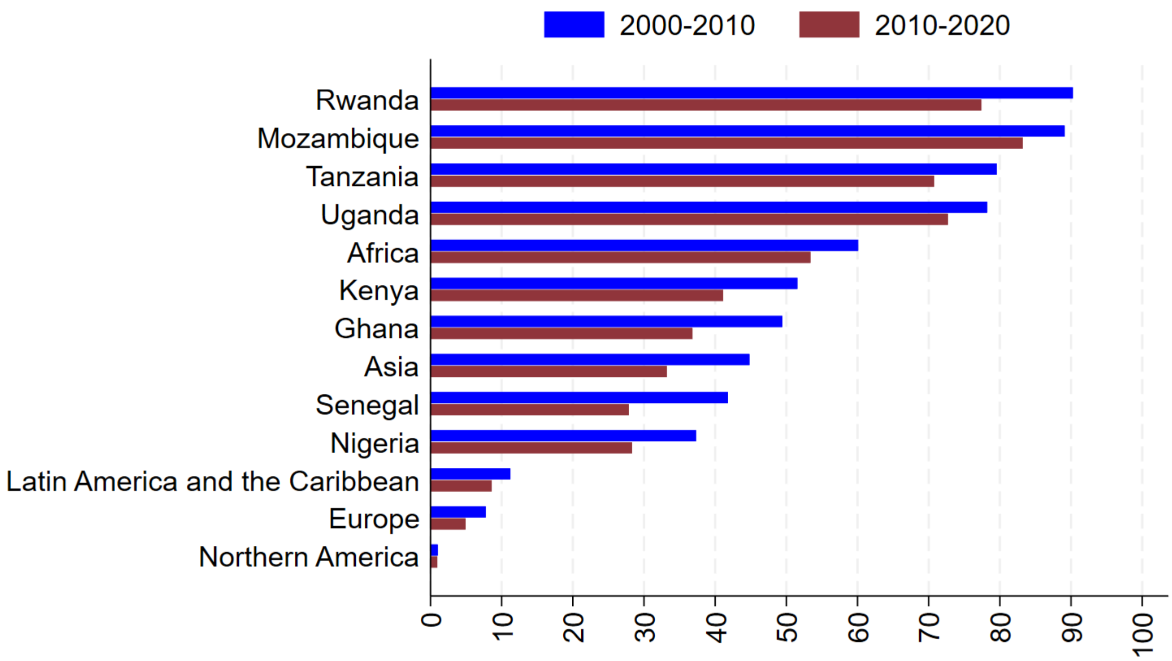
[6] http://www.ag-incentives.org

[7] The list of countries is provided in the Appendix.

[8] FAO (2011) mentioned that, "If women in rural areas had the same access to productive activities as men, agricultural and farming production would increase, and we could feed approximately 150 million more people."

compared to men. Therefore, without fixing these market failures, the expected contribution of women's participation is unclear.

Figure 19: Participation of women in the agricultural sector in Africa



Source: FAOSTAT, author's calculations.

Table 3: Description of variables used in the model, average over the period 1990–2019

Region	Africa	Americas	Asia	Europe	Oceania
FSSR (%)	88.72	110.92	82.22	100.09	191.15
NRA (%)	-4.33	9.43	27.63	19.53	2.52
GDP per capita ($ constant)	1251.59	15163.83	9280.98	9943.36	40604.64
Women's participation in ag sector (%)	57.877381	6.521429	34.974026	21.320958	4.053571
Arable land area (ha/capita)	255.96	389.27	241.66	1043.38	719.83
Share of rural population (%)	67.54	22.72	49.72	32.33	14.51
Share of agriculture in total GDP (%)	26.81	6.25	13.08	8.25	4.45
Terms of trade adjustment (x1000)	-0.12	-1.13	9.86	0.55	-0.04
Domestic food price index (DFPI) (Base 100=2015)	56.49	59.37	64.02	61.17	82.19

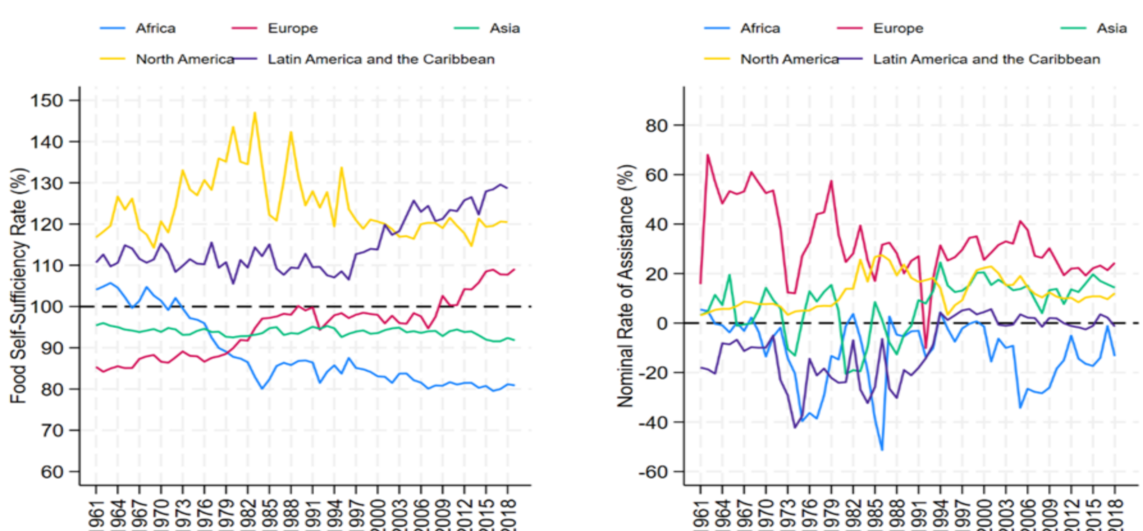
Source: Authors.

Results

Descriptive Analysis

We analyze here the link between food self-sufficiency and agricultural support. Figure 16 presents the evolution of food self-sufficiency and the NRA. Overall, agricultural support and protection have changed substantially in almost all regions. No clear trend appears at first sight. For instance, in Europe food self-sufficiency is improving as agricultural support decreases, while in Africa we observe a stagnation of agricultural support (taxation) and a deterioration of the food self-sufficiency ratio. We can observe, however, that food self-sufficiency has decreased substantially in almost all regions except Europe, over the 1961–2018 period. Also, agricultural support or protection has decreased substantially in the European Union, while in the other regions there is no clear trend. In addition, the spread of the NRA between regions has decreased over time. In Africa, the NRA was almost always negative during the period of observation, which means net taxation of farmers in that region. It is important to keep in mind the potential aggregation bias across country and product dimensions. Many governments tax trade in both directions, with positive NRA of sensitive products to support producers and negative NRA of non-sensitive products to protect consumers.

Figure 20: Evolution of the NRA and the food self-sufficiency ratio, 1961–2018



Source: FAOSTAT (2023), Ag-Incentives (2023), author's calculations.

Econometric results

Table 4 shows that agricultural protection and food self-sufficiency move in a nonlinear way. Overall, agricultural support has a positive effect on food self-sufficiency, but the effect decreases at high levels of agricultural support. Since the level of agricultural support is linked to the level of development (Swinnen et al., 1999), the nonlinear relationship also reflects the diminishing impact of agricultural support on food self-sufficiency. Indeed, the impact is lower in developed countries (high GDP per capita) than in developing countries (low GDP per capita). The comparison of the standard IV regression with the quantile approach shows that there is heterogeneity in the response of food self-sufficiency to agricultural support—in general, the higher the quantile, the lower the impact (see Table 5). The results in Africa do not always differ from the rest of the world, apart from the higher thresholds from which agricultural support starts having a negative impact on food self-sufficiency, and the quantile regression results which are not really different to the standard IV regression (see Table 5 and Table 6).

Other factors also affect food self-sufficiency. The level of development and arable land per capita (comparative advantage in agriculture) positively impact food self-sufficiency, while the density of the population and the terms of trade negatively impact food self-sufficiency.

The participation of women is not statistically significant, regardless of which specification is considered. As previously mentioned, the expected sign for this variable is ambiguous and the results may imply that the two effects cited are canceling each out.

Finally, our results are robust to the treatment of EU as a single region or not (considering individual EU countries with the NRA of the region) (see Table 6).

Table 4: Estimation results of the link between world agricultural protection and food self-sufficiency with instrumental variables

Dependent variable: FSSR	***IVREG No quantile***	***IVQREG q=0.25***	***IVQREG q=0.5***	***IVQREG q=0.75***	***IVREG OLS***	***IVQREG q=0.25***	***IVQREG 0.5***	***IVQREG q=0.75***
NAC	0.74***	1.00***	0.74***	0.48*	1.37***	1.36***	1.37***	1.38***
	(0.18)	(0.24)	(0.20)	(0.29)	(0.27)	(0.34)	(0.27)	(0.38)
NAC2	-0.36***	-0.45***	-0.36***	-0.28**				
	(0.07)	(0.10)	(0.09)	(0.12)				
Threshold[9]	1.03	1.11	1.03					
NACXLog_gdp					-0.17***	-0.16***	-0.17***	-0.19***
					(0.03)	(0.04)	(0.03)	(0.05)
Log_gdp_capita	-0.07	-0.04	-0.07	-0.09	0.09	0.09	0.08	0.08
	(0.05)	(0.07)	(0.05)	(0.08)	(0.06)	(0.08)	(0.06)	(0.09)
Women_Parti_Agr	0.02	0.00	0.01	0.03	-0.03	-0.05	-0.03	-0.01
	(0.09)	(0.12)	(0.10)	(0.15)	(0.08)	(0.13)	(0.10)	(0.14)
Log_ArableLand_capita	0.21***	0.24***	0.21***	0.19***	0.21***	0.24***	0.21***	0.18***
	(0.04)	(0.05)	(0.04)	(0.06)	(0.04)	(0.05)	(0.04)	(0.06)
log_Pop_Density	-0.69***	-0.57***	-0.69***	-0.80***	-0.76***	-0.65***	-0.77***	-0.89***
	(0.07)	(0.10)	(0.08)	(0.12)	(0.08)	(0.11)	(0.08)	(0.12)
Share_Rur_Pop	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Share_AGR_GDP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TOT	-0.28**	-0.32**	-0.28**	-0.25	-0.29**	-0.30**	-0.29***	-0.27*
	(0.14)	(0.13)	(0.11)	(0.16)	(0.11)	(0.13)	(0.11)	(0.15)
DFPI	-0.00	-0.00	-0.00	0.00	-0.00	-0.00	-0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
trend	0.02***	0.02***	0.02***	0.02***	0.02***	0.02***	0.02***	0.02***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Number of observations	953	953	953	953	953	953	953	953
Number of countries	42	42	42	42	42	42	42	42

Source: Author's calculations.
Note: * p<0.10, ** p<0.05, *** p<0.01 : IVREG means regression with instrumental variables : IVQREG means quantile regression with instrumental variable; European union countries members take the NRA of the EU region ; NAC=NRA+1.

[9] The threshold (NAC level) is computed by solving the equation $a*NAC+b*NAC^2=0$.

Table 5: Estimation results of link between African agricultural protection and food self-sufficiency with instrumental variables

Dependent variable: FSSR	*Africa*							
	IVREG OLS	***IVQREG q=0.25***	***IVQREG q=0.5***	***IVQREG q=0.75***	***IVREG OLS***	***IVQREG q=0.25***	***IVQREG q=0.5***	***IVQREG q=0.75***
NAC	0.81**	0.80**	0.81**	0.81	0.76**	0.78*	0.75**	0.74*
	(0.32)	(0.35)	(0.39)	(0.62)	(0.38)	(0.46)	(0.31)	(0.38)
NAC2	-0.32**	-0.31*	-0.33*	-0.34				
	(0.14)	(0.16)	(0.18)	(0.29)				
Threshold	1.26	1.29	1.22					
NACXLog_gdp					-0.09*	-0.09	-0.09**	-0.09*
					(0.05)	(0.07)	(0.04)	(0.05)
Log_gdp_capita	0.09**	0.09*	0.09*	0.09	0.15***	0.16**	0.15***	0.15***
	(0.04)	(0.05)	(0.05)	(0.09)	(0.05)	(0.06)	(0.04)	(0.05)
Women_Parti_Agr	0.17	0.23	0.16	0.10	0.19	0.26	0.18	0.11
	(0.12)	(0.17)	(0.19)	(0.30)	(0.13)	(0.17)	(0.12)	(0.14)
Log_ArableLand_capita	0.05	0.06	0.05	0.04	0.08*	0.09*	0.08**	0.06
	(0.04)	(0.05)	(0.05)	(0.08)	(0.04)	(0.05)	(0.03)	(0.04)
log_Pop_Density	-0.16	-0.26	-0.15	-0.05	-0.13	-0.22	-0.13	-0.05
	(0.14)	(0.16)	(0.18)	(0.29)	(0.14)	(0.18)	(0.12)	(0.14)
Share_Rur_Pop	-0.01***	-0.01***	-0.01**	-0.01	-0.01*	-0.01	-0.01**	-0.00
	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Share_AGR_GDP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TOT	-0.09	-0.07	-0.10	-0.12	1.38	1.50	1.37	1.26
	(1.06)	(1.31)	(1.47)	(2.32)	(1.25)	(1.45)	(0.98)	(1.20)
DFPI	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00	-0.00*	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
trend	-0.00	0.00	-0.00	-0.01	-0.00	0.00	-0.00	-0.00
	(0.00)	(0.01)	(0.01)	(0.01)	(0.00)	(0.01)	(0.00)	(0.00)
N	260.00	260.00	260.00	260.00	260.00	260.00	260.00	260.00
Number of countries	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00

* p<0.10, ** p<0.05, *** p<0.01; IVREG means regression with instrumental variables; IVQREG means quantile regression with instrumental variable

NB: FSSR and NAC are in level, not in percent.

Source: Author's calculations.

Table 6: Estimation results of the link between world agricultural protection and food self-sufficiency with instrumental variables

Dependent variable: FSSR	*EU countries take the NAC of the EU region*							
	IVREG OLS	***IVQREG q=0.25***	***IVQREG q=0.5***	***IVQREG q=0.75***	***IVREG OLS***	***IVQREG q=0.25***	***IVQREG q=0.5***	***IVQREG q=0.75***
NAC	0.47***	0.65***	0.47***	0.28	1.08***	0.94***	1.08***	1.23**
	(0.13)	(0.22)	(0.17)	(0.25)	(0.20)	(0.27)	(0.35)	(0.63)
NAC2	-0.22***	-0.25***	-0.22***	-0.18**				
	(0.05)	(0.08)	(0.06)	(0.09)				
Threshold	1.07	1.30	1.07					
NACXLog_gdp					-0.18***	-0.14***	-0.18***	-0.22**
					(0.03)	(0.04)	(0.06)	(0.10)
Log_gdp_capita	0.09**	0.12**	0.09*	0.05	0.23***	0.24***	0.23***	0.23
	(0.04)	(0.06)	(0.05)	(0.07)	(0.05)	(0.07)	(0.09)	(0.16)
Women_Parti_Agr	-0.05	-0.09	-0.04	0.00	-0.08	-0.12	-0.07	-0.02
	(0.10)	(0.15)	(0.12)	(0.17)	(0.11)	(0.13)	(0.17)	(0.30)
Log_ArableLand_capita	0.19***	0.20***	0.19***	0.18***	0.19***	0.21***	0.19***	0.17
	(0.04)	(0.06)	(0.04)	(0.06)	(0.04)	(0.05)	(0.06)	(0.11)
log_Pop_Density	-0.47***	-0.40***	-0.47***	-0.56***	-0.53***	-0.44***	-0.53***	-0.63***
	(0.05)	(0.09)	(0.07)	(0.10)	(0.05)	(0.08)	(0.11)	(0.19)
Share_Rur_Pop	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
Share_AGR_GDP	-0.00	0.00	-0.00	-0.00	-0.00	0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
TOT	-0.40***	-0.43**	-0.40***	-0.36*	-0.40***	-0.41***	-0.40**	-0.38
	(0.15)	(0.17)	(0.13)	(0.19)	(0.14)	(0.14)	(0.19)	(0.34)
DFPI	0.00***	0.00	0.00***	0.00***	0.00***	0.00	0.00*	0.00*
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
trend	0.00**	0.00	0.00	0.00	0.00**	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
N	1527.00	1527.00	1527.00	1527.00	1527.00	1527.00	1527.00	1527.00
Number of countries	67.00	67.00	67.00	67.00	67.00	67.00	67.00	67.00

Source: Author's calculations.

Note: * p<0.10, ** p<0.05, *** p<0.01 ; EU countries take the NRA of the EU region.

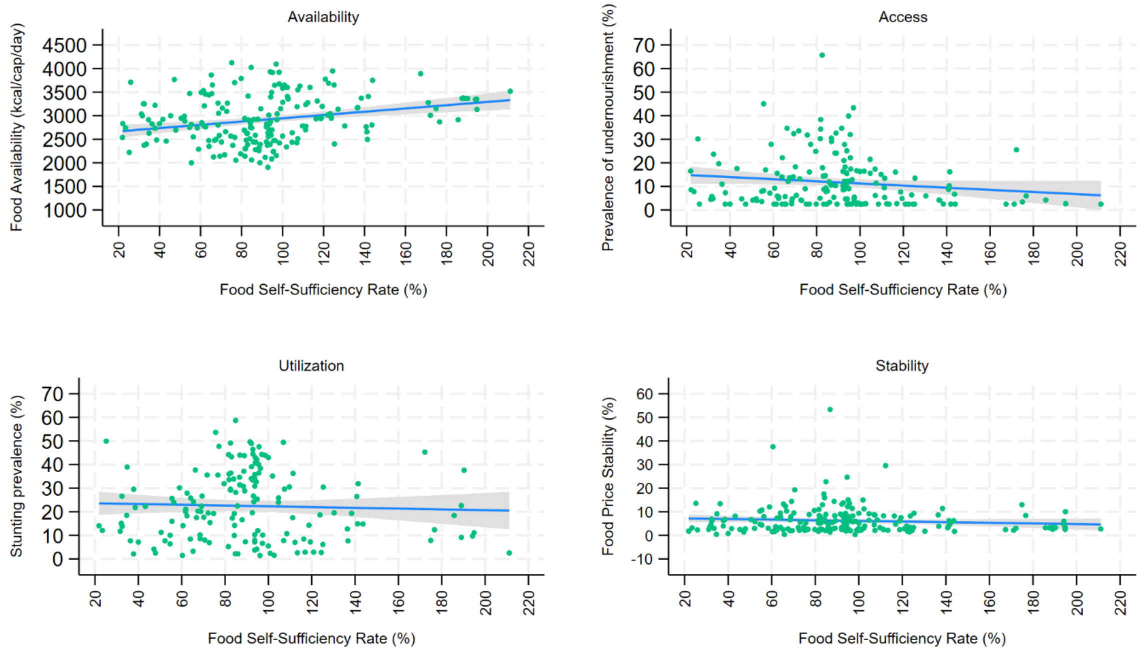
Links between food self-sufficiency and food security

Figure 21 and Table 7 (ad hoc estimation of the structural equation modeling) present the link between food self-sufficiency and food security pillars. They show a positive and significant link between food self-sufficiency and the two first dimensions of food security (availability and food access). No significant link is found between food self-sufficiency and the other two dimensions of food security. Countries that can produce enough food to feed their own population are food self-sufficient and ensure the domestic availability and access of food. For Africa, the only significant link is observed between food self-sufficiency and utilization (Figure 22 and Table 7). It is important though to keep in mind that the overall food self-sufficiency of a country does not ensure the domestic availability of food, as this depends on the net trade position of the country. The link between food self-sufficiency and the other two dimensions of food security is context specific and depends on many factors. A detailed analysis below reveals that food self-sufficiency is neither necessary nor sufficient to achieve food security.

Source: **FAOSTAT, author's estimations.**

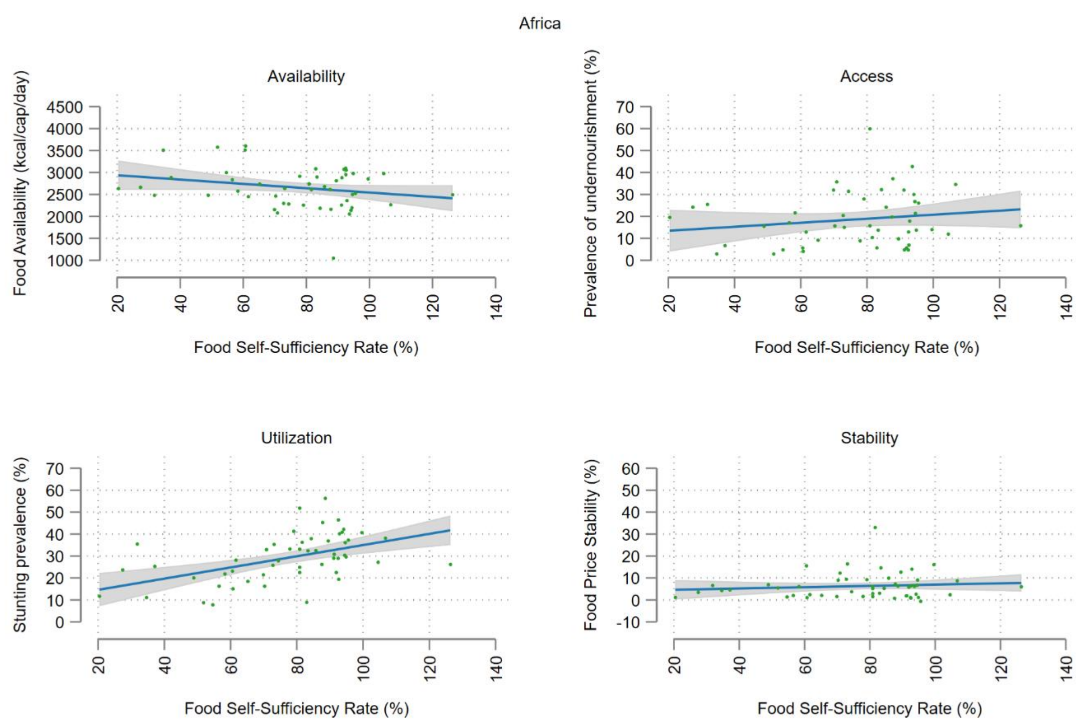
Table 8 presents a typology of countries based on food self-sufficiency and food security (food access). It highlights the fact that there is no one-size-fits-all strategy to achieve food security, but in relative terms, countries that are food self-sufficient have a low level of food insecurity. There are countries that are food self-sufficient with low to moderate levels of food insecurity (86% of the mainly net exporters). This group mainly comprises mainly net exporters in rich and middle-income countries (EU, US, and some Latin American countries) where domestic supply provides a basis for food security thanks to favorable conditions for agriculture. However, another small group of net exporter countries that are self-sufficient still suffer from food insecurity (14%), including Bolivia, Guatemala, and Zambia . On the other hand, there is another group of countries that are not self-sufficient but do observe low levels of food insecurity (72% of the mainly net importers). These countries are mainly net importers and are located in different areas such as Europe (Norway), Asia (Japan), the Middle East and North Africa (Tunisia), or sub-Saharan Africa (Cameroon). For these countries, international trade contributes to food security in particular through the revenues from natural resources (MENA countries). These results are in accordance with the findings of Baer-Nawrocka and Sadowski (2019). Finally, the last group of countries is neither food self-sufficient nor food secure (28% of the mainly net importers). This group, which comprises mainly net importers, includes many African countries and the continent (as whole). Five out of the eight focus countries of this study are in this group (Kenya, Mozambique, Rwanda, Tanzania, and Uganda). For these countries, domestic production and international trade are insufficient to achieve food security.

Figure 21: Link between food self-sufficiency and food security (food availability, food access, food utilization, and food price stability), average from 2010 to 2019



Source: FAOSTAT, author's calculations.

Figure 22: Link between food self-sufficiency and food security (food availability, food access, food utilization, and food price stability), average from 2010 to 2019 in Africa



Source: FAOSTAT, author's calculations.

Table 7: Link between food self-sufficiency and food security (food availability, food access, food utilization, and food price stability), average from 2010 to 2019

	Structural Equation Modeling	
	World	Africa
Food Availability		
FSSR	2.58**	-4.23
	(1.01)	(2.49)
Constant	2709.07***	3004.05***
	(96.64)	(198.41)
FoodAccess		
FSSR	-0.06**	0.09
	(0.03)	(0.08)
Constant	16.59***	11.60
	(2.39)	(6.11)
Food_Utilization		
FSSR	-0.02	0.24***
	(0.03)	(0.05)
Constant	21.94***	9.86*
	(2.97)	(4.34)
FoodStability		
FSSR	-0.01	0.03
	(0.02)	(0.04)
Constant	7.06***	4.09
	(1.49)	(3.03)
var(e.FoodAvailability)	1.8e+05***	1.5e+05***
	(21397.22)	(29535.09)
var(e.FoodAccess)	108.45***	138.50***
	(13.06)	(27.98)
var(e.Food_Utilization)	168.37***	69.89***
	(20.27)	(14.12)
var(e.FoodStability)	42.16***	34.15***
	(5.08)	(6.90)
N	138.00	49.00
LR test (Chi (6))	217.96***	57.85***

Source: FAOSTAT, author's estimations.

Table 8: Typology of countries (food self-sufficiency vs. food access (PoU)), average over the period 2010–2019

	Food self-sufficient (FSSR>=100%)	*Not food self-sufficient (100%<FSSR<=80%)*	*Not food self-sufficient (FSSR<80%)*
Low level of food in-security *(PoU <5%)*	***Mainly net exporters*** *ARG; AUS; BGR; BLR; BRA; CAN; CZE; DNK; EST; Eu-rope; FRA; HRV; HUN; KAZ; LTU; LVA; MDA; NAC; NZL; POL; PRY; ROU; RUS; SRB; SVK; UKR; URY; USA* ***(28)***	***Mainly net importers*** *AUT: CHN; CMR; CRI; DEU ; FIN ; MLI ; SWE ; TUR ; UZB* ***(8)***	***Mainly net importers*** *ALB; ARM; AZE; BEL; BIH; BRB; CHE; CHL; CUB; CYP; DZA; ESP; GBR: GEO; GRC; IRL; ISR; ITA; JPN; KOR; LUX; MAR; MEX; MKD: NLD; NOR; PRT; SVN; SYC: TUN: VCT* ***(31)***
5%<=PoU<10%	***Mainly net exporters*** *BLZ; GUY; IDN; KHM; LAC; LAO; MYS; Oce-ania; THA; VNM (9)*	***Mainly net importers*** *Asia; COL; FJI; GHA; MMR; MUS; NGA; NPL; PHL; SUR; TKM; ZAF* ***(12)***	***Mainly net importers*** *ARE; BEN; DMA; DOM; EGY; IRN; JAM; KGZ; MNG; MRT; NCL; OMN; PAN; PER; PYF; SEN; SLV; WSM* ***(18)***
10%<=PoU<15%	***Mainly net exporters*** *CIV; ECU; KIR; VUT* ***(4)***	***Mainly net importers*** *BFA; GIN; HND; IND; MWI; NER; PAK; SDN* ***(8)***	***Mainly net importers*** *BGD; COM; LKA': SYR; TTO; VEN* ***(6)***
Moderate to high level of food insecu-rity *(PoU>15%)*	***Mainly net exporters*** *BOL; GTM; PNG; SLB; SWZ; ZMB* ***(6)***	***Mainly net importers*** ***Africa****; CAF; COD; ETH; GNB; MDG; NIC; PRK;* ***RWA****; SLE; SOM; TCD; TGO;* ***TZA****;* ***UGA (15)***	***Mainly net importers*** *AFG; AGO; BWA; COG; CPV; GAB; GMB; HTI; IRQ; KEN; LBR; LSO; MOZ; NAM; STP; TJK; TLS; ZWE* ***(18)***

Source: FAOSTAT, author's calculations.

Note: See Appendix for the country names corresponding to the ISO3 codes.

CONCLUSION

Food security remains problematic in Africa and has not changed significantly over the previous decades. The level of food self-sufficiency is also quite low and has not changed substantially over the years. In the context of recurrent crisis (2008 food crisis, COVID-19 pandemic, Russia-Ukraine war), Africa's exposure to global shocks continues to raise legitimate concerns. However, while food self-sufficiency is promoted by policymakers as a strategy to achieve food security, support to and protection of the agricultural sector is still very low in Africa. Our findings show that agricultural support and protection do impact food self-sufficiency, but in a nonlinear way, with threshold effects. These threshold effects reflect the positive link between agricultural support and countries' level of development, the so-called "developmental paradox" (De Gorter and Swinnen, 2002),

Our results show that food self-sufficiency is neither a necessary nor a sufficient condition for achieving all the dimensions of food security. There are mixed ways to achieve food security and there is no "one-size-fits-all strategy." International and regional trade can contribute substantially to food security and stabilizing domestic food markets, as regional production is most often less volatile than domestic supply (Badiane and Odjo, 2013). When intervening to protect domestic markets, a balanced and context-specific approach is necessary, with considerations such as the degree of concentration (and "thinness") of the international markets, the evolution of terms of trade, and other factors.

Finally, the analysis performed in this study showed the excessive use of second-best policy instruments in Africa, mainly restrictive trade policies, to support the agricultural sector. The small difference between the nominal rate of assistance and the nominal rate of protection reflects this feature. Yet, economic theory in this context recommends the use of first-best instruments that will directly target the source of the problem. As is observed in developed countries, a switch to such policies will probably be observed as the continent's economy continues to grow.

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ENDNOTES

APPENDIXES Appendix 1: List of countries selected for the study

Europe	Africa	America	Asia	Oceania
Austria	Benin	Argentina	China	Australia
Belgium	Burkina Faso	Brazil	Indonesia	New Zealand
Switzerland	Ethiopia	Canada	India	
Czechia	Ghana	Chile	Israel	
Germany	Kenya	Colombia	Japan	
Denmark	Mali	Dominican Republic	Korea	
Spain	Mozambique	Ecuador	Sri Lanka	
Estonia	Nigeria	Mexico	Pakistan	
Finland	Senegal	Nicaragua	Philippines	
France	Tanzania	United States	Vietnam	
Great Britain	Uganda			
Gibraltar	South Africa			
Greece				
Hungary				
Ireland				
Iceland				
Italia				
Liechtenstein				
Lithuania				
Luxembourg				
Latvia				
Malta				
Netherlands				

Norway				
Poland				
Portugal				
Romania				
Russia				
Slovakia				
Slovenia				
Sweden				
Ukraine				

Source: Ag-Incentives.

Appendix 2: Correspondence between ISO3 codes and the names of countries

ISO3	Country Name	ISO3	Country Name
ABW	Aruba	CHE	Switzerland
AFG	Afghanistan	CHL	Chile
AGO	Angola	CHN	China
AIA	Anguilla	CIV	Cote d'Ivoire
ALB	Albania	CMR	Cameroon
AND	Andorra	COD	Democratic Republic of Congo
ANT	Netherlands Antilles	COG	Congo
ARE	United Arab Emirates	COK	Cook Islands
ARG	Argentina	COL	Colombia
ARM	Armenia	COM	Comoros
ASM	American Samoa	CPV	Cape Verde
ATG	Antigua and Barbuda	CRI	Costa Rica
AUS	Australia	CUB	Cuba
AUT	Austria	CYM	Cayman Islands
AZE	Azerbaijan	CYP	Cyprus
BDI	Burundi	CZE	Czech Republic
BEL	Belgium	DEU	Germany
BEN	Benin	DJI	Djibouti
BFA	Burkina Faso	DMA	Dominica
BGD	Bangladesh	DNK	Denmark
BGR	Bulgaria	DOM	Dominican Republic
BHR	Bahrain	DZA	Algeria
BHS	Bahamas	ECU	Ecuador
BIH	Bosnia and Herzegovina	EGY	Egypt
BLR	Belarus	ERI	Eritrea
BLZ	Belize	ESH	Western Sahara

BMU	Bermuda	ESP	Spain
BOL	Bolivia	EST	Estonia
BRA	Brazil	ETH	Ethiopia
BRB	Barbados	FIN	Finland
BRN	Brunei	FJI	Fiji
BTN	Bhutan	FLK	Falkland Islands
BWA	Botswana	FRA	France
CAF	Central African Republic	FRO	Faeroe Islands
CAN	Canada	FSM	Micronesia
GAB	Gabon	LBN	Lebanon
GBR	United Kingdom	LBR	Liberia
GEO	Georgia	LBY	Libya
GHA	Ghana	LCA	Saint Lucia
GIN	Guinea	LIE	Liechtenstein
GLP	Guadeloupe	LKA	Sri Lanka
GMB	Gambia	LSO	Lesotho
GNB	Guinea-Bissau	LTU	Lithuania
GNQ	Equatorial Guinea	LUX	Luxembourg
GRC	Greece	LVA	Latvia
GRD	Grenada	MAC	Macao
GRL	Greenland	MAR	Morocco
GTM	Guatemala	MCO	Monaco
GUF	French Guiana	MDA	Moldova
GUM	Guam	MDG	Madagascar
GUY	Guyana	MDV	Maldives
HKG	Hong Kong	MEX	Mexico
HND	Honduras	MHL	Marshall Islands
HRV	Croatia	MKD	Macedonia
HTI	Haiti	MLI	Mali
HUN	Hungary	MLT	Malta
IDN	Indonesia	MMR	Myanmar
IND	India	MNG	Mongolia
IRL	Ireland	MOZ	Mozambique
IRN	Iran	MRT	Mauritania
IRQ	Iraq	MSR	Montserrat
ISL	Iceland	MTQ	Martinique
ISR	Israel	MUS	Mauritius
ITA	Italy	MWI	Malawi
JAM	Jamaica	MYS	Malaysia
JOR	Jordan	NAM	Namibia
JPN	Japan	NCL	New Caledonia
KAZ	Kazakhstan	NER	Niger
KEN	Kenya	NGA	Nigeria
KGZ	Kyrgyz Republic	NIC	Nicaragua

KHM	Cambodia	NIU	Niue
KIR	Kiribati	NLD	Netherlands
KNA	Saint Kitts and Nevis	NOR	Norway
KOR	South Korea	NPL	Nepal
KWT	Kuwait	NRU	Nauru
LAO	Laos	NZL	New Zealand
OMN	Oman	TGO	Togo
PAK	Pakistan	THA	Thailand
PAN	Panama	TJK	Tajikistan
PER	Peru	TKM	Turkmenistan
PHL	Philippines	TLS	Timor
PLW	Palau	TON	Tonga
PNG	Papua New Guinea	TTO	Trinidad and Tobago
POL	Poland	TUN	Tunisia
PRI	Puerto Rico	TUR	Turkey
PRK	North Korea	TUV	Tuvalu
PRT	Portugal	TZA	Tanzania
PRY	Paraguay	UGA	Uganda
PSE	Palestine	UKR	Ukraine
PYF	French Polynesia	URY	Uruguay
QAT	Qatar	USA	United States
REU	Reunion	UZB	Uzbekistan
ROU	Romania	VCT	Saint Vincent and the Grenadines
RUS	Russia	VEN	Venezuela
RWA	Rwanda	VGB	British Virgin Islands
SAU	Saudi Arabia	VIR	United States Virgin Islands
SDN	Sudan	VNM	Vietnam
SEN	Senegal	VUT	Vanuatu
SGP	Singapore	WSM	Samoa
SHN	Saint Helena	YEM	Yemen
SLB	Solomon Islands	YUG	Yugoslavia
SLE	Sierra Leone	ZAF	South Africa
SLV	El Salvador	ZMB	Zambia
SMR	San Marino	ZWE	Zimbabwe
SOM	Somalia		
SRB	Yugoslavia		
SSD	South Sudan		
STP	Sao Tome and Principe		
SUR	Suriname		
SVK	Slovak Republic		
SVN	Slovenia		
SWE	Sweden		
SWZ	Swaziland		
SYC	Seychelles		

SYR	Syria		
TCA	Turks and Caicos Islands		
TCD	Chad		

Source: FAOSTAT.

Appendix 2: Robustness check: validity of instruments: Estimation results of link between agricultural protection and food self-sufficiency with instrument variables in the world (Note: EU treated as one region)

```
Estimates efficient for homoskedasticity only
Statistics robust to heteroskedasticity

                                                      Number of obs =      953
                                                      F( 11,    900) =    13.00
                                                      Prob > F      =   0.0000
Total (centered) SS     =  18.66738719               Centered R2   =   0.0978
Total (uncentered) SS   =  18.66738719               Uncentered R2 =   0.0978
Residual SS             =  16.84201367               Root MSE      =     .136
```

FSSR	Coefficient	Robust std. err.	z	P>|z|	[95% conf.	interval]
NAC	1.338341	.5397175	2.48	0.013	.2805137	2.396167
NAC2	-.5582121	.2480616	-2.25	0.024	-1.044404	-.0720202
Log_gdp_capita	-.0423604	.0548712	-0.77	0.440	-.1499058	.0651851
IND_Sh_Fem_Employment_ILO	.091713	.0907469	1.01	0.312	-.0861478	.2695737
Log_ArableLand_capita	.2247449	.0374004	6.01	0.000	.1514414	.2980484
log_Pop_Density	-.6263998	.0873219	-7.17	0.000	-.7975477	-.4552519
Share_Rur_Pop	-.0017466	.0025948	-0.67	0.501	-.0068322	.0033391
Share_AGR_GDP	.0016805	.0014725	1.14	0.254	-.0012054	.0045665
TOT	-.1721443	.1270362	-1.36	0.175	-.4211307	.076842
DFPI	-.0002483	.0004032	-0.62	0.538	-.0010385	.0005418
trend	.0155229	.0026385	5.88	0.000	.0103516	.0206943

```
Underidentification test (Kleibergen-Paap rk LM statistic):                5.412
                                                   Chi-sq(1) P-val =    0.0200
------------------------------------------------------------------------------
Weak identification test (Cragg-Donald Wald F statistic):                 31.642
                         (Kleibergen-Paap rk Wald F statistic):            2.670
Stock-Yogo weak ID test critical values: 10% maximal IV size               7.03
                                         15% maximal IV size               4.58
                                         20% maximal IV size               3.95
                                         25% maximal IV size               3.63
Source: Stock-Yogo (2005).  Reproduced by permission.
NB: Critical values are for Cragg-Donald F statistic and i.i.d. errors.
------------------------------------------------------------------------------
Hansen J statistic (overidentification test of all instruments):           0.000
                                                 (equation exactly identified)
-endog- option:
Endogeneity test of endogenous regressors:                                16.839
                                                   Chi-sq(2) P-val =    0.0002
Regressors tested:     NAC NAC2
------------------------------------------------------------------------------
Instrumented:          NAC NAC2
Included instruments:  Log_gdp_capita IND_Sh_Fem_Employment_ILO
                       Log_ArableLand_capita log_Pop_Density Share_Rur_Pop
                       Share_AGR_GDP TOT DFPI trend
Excluded instruments:  NAC_MA NAC_MA2
```

Source: Author's calculation

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